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THE VIRGINIA
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Vol. 8, New Series April, 1957 No. 2

Human Engineering: Applied Experimental Psychology

Richard H. Henneman

University of Virginia

Probably no development in Psychology in the last quarter-century has so appealed to the imagination of professional psychologists and the American public alike, as human engineering. Born in the latter days of World War II, this area of psychology has gained widening recognition and increased momentum in the relatively brief span of ten years. Informally, human engineering has been called the attempt "to fit the machine to the man" a striking reversal of the time-honored task of the personnel selection psychologist. More accurately, human engineering research involves the application of experimental psychology to the design of equipment so that it will be better adapted to the capacities and limitations of the human operator. The rationale is simply that an optimally designed machine is safer to operate, is less fatiguing, requires less training to master, and enables the operator to attain a higher level of proficiency. A few familiar examples will illustrate the concept.

Can you readily tell which knob controls which burner on your kitchen range, or which is the volume control knob of your radio or TV set? What color combinations in highway signs are most easily detected from a moving automobile? Can you quickly and accurately read your dashboard instruments at night, or discriminate by touch the various control knobs in your car? Does your turn indicator flash brightly enough or provide an auditory signal to remind you it is still on when you change your mind about making a turn? The tinted glass in automobile windshields has led to serious problems of reduced night visibility, especially for old people, and to anguished protests from the drive-in movie people! A new typewriter keyboard is now being tried out experimentally on a group of government secretaries in Washington. This keyboard was redesigned to achieve a better load distribution between

the left and right hands, and among the respective fingers — on the basis of strength and agility tests.

The term "human engineering" is perhaps an unfortunate designation for this area of investigation. This name was first used by Johnson O'Connor to identify his procedure for aptitude testing and vocational counseling. The title has also been employed by the authors of some applied and industrial psychology textbooks to embrace the entire area of industrial efficiency, including conditions of work, time and motion studies, fatigue, and related topics having to do with work output. Writers in the field of personnel management have applied the label of "human engineering" to the whole complex field of "human relations," including leadership, morale, advertising, and selling. Research psychologists working on problems of equipment design have suggested such terms as *biomechanics, biotechnology,* and *psychotechnology* in place of *human engineering*. The writer would agree with those who argue for the more neutral title of *engineering psychology* (5) to cover this area of joint activity by psychologists and engineers. However, the use of "human engineering" has become so widespread that it seems unlikely to be superseded by any other title in the next few years.

How has the psychologist approached the problem of designing complex equipment in line with human capacities and limitations? The basic ideas are simple, though the necessary investigations have been beset with peculiar methodological difficulties. The displays and controls of the machine are regarded as essentially extensions of man's sense organs and muscles. The displays or indicators serve to present stimulus data for the operator to make use of in deciding upon appropriate responses. The purpose of the controls is to enable a more effective manipulation of the environment. Neither of these is a very recent idea in the history of human invention. The telescope, the microscope, and radar are examples of visual aids extending the informational intake capacity of the eyes. On the behavioral side, the successive inventions of the wheel and axle, the stirrup, and the engine, have revolutionized locomotion and transportation, not to mention warfare.

The process of adapting the displays and controls of machines to the human operator has involved extensive programs of research relating to the efficient presentation of information through various sense channels, the assimilation of this information by the operator, and an analysis of behavior on the human output side. Thus questions have had to be answered relative to human sensory capacities, and various intellectual functions (such as identification, interpretation, retention, computation, and decision-making) as well as those concerned with a wide range of motor responses. The term "information processing" has been applied to the complex functions by which the human operator receives and makes

appropriate use of information from his environment.

Interest in equipment design problems arose in World War II, growing out of difficulties encountered in attempting to train men to high proficiency levels in the operation of complex mechanisms such as bomb-sights, and the controls involved in operating tanks, submarines, and aircraft. It was found that even the most highly selected and trained personnel were not too successful in the operation of some of the complex equipment which had evolved in modern mechanized warfare. A closer examination of the problem revealed that the equipment had frequently been poorly designed for comfort, safety, or efficiency of operation by the species, *Homo sapiens*. Tanks were found with accelerators 16 inches from the seat (when the driver was in the "buttoned up" situation); bomb-sights might require the simultaneous use of three arms, or two pairs of eyes; radically different controls (such as those for the flaps and landing gear on aircraft) would be placed adjacent in space, with identical shapes, and out of visual range. Pilots complained that radio headsets numbed their ears.

The early investigators of man-machine operation concluded from their studies that as machines become increasingly complex, the additional demands upon the operator's attention, skill, and memory bring about a point where selection and training can no longer guarantee a high level of operator proficiency. Military planners became convinced that properly engineered equipment plays a crucial role in determining operator proficiency in combat. To the traditional "three-legged stool" of *selection*, *training*, and *supervision*, there was added a fourth component of successful operations — namely, *optimally designed equipment*.

The background information essential to human engineering research is collected from several sources by a variety of techniques. The men actually using the equipment may be interviewed or polled by questionnaires and check-lists to learn about operating difficulties, and sources of discomfort, fatigue, or error. Job analysis of actual man-machine operation has been fruitful in revealing ideas for modification or redesign. Error analyses of records such as those of gunnery practice, or bombing missions, have afforded valuable data as to malfunctioning. Finally, the investigation of accidents, especially those on the highway, and in the air, has led to suggestions for eliminating potential hazards built into passenger cars, trucks, and aircraft.

Human engineering research has necessitated a close liaison between psychologists on the one hand and engineers, physicists, and mathematicians on the other. The psychologists have had the task of pursuading the design engineers of the necessity of considering the characteristics of the human operator as an essential "link" in the man-machine

system. On the other hand, the psychologist has had to learn something about machines, engineering principles, and mathematics in order to discuss and contribute effectively to the technical problems of the design engineer. It has been a process of mutual indoctrination and research effort, a process not easy for either party at the outset, but one which has, on the whole, evolved harmoniously and profitably. There are fast developing breeds of psychologically-oriented engineers and machine-oriented psychologists who are able to talk each other's language with a reasonable degree of mutual understanding and appreciation. Modern human engineering research often entails the cooperative efforts of teams of specialists, each one of whom contributes information from his own field to the solution of common problems. Members of such research teams may include medical scientists, biophysicists, psysiologists, and mathematicians, in addition to experimental psychologists and engineers.

The activities of human engineering psychologists may be said to take place on three levels. The first of these consists primarily of professional consultation with design engineers on immediate problems of equipment already in process of construction. The second level involves research on practical problems specifically applicable to operational situations, such as how best to encode altitude and range information on a cathode ray tube display, or how much torque to put into a control device for optimum manual operation, or whether a pilot can respond to control instructions better when they are presented as voice messages over a radio telephone, or displayed visually in symbolic form. The third level involves basic laboratory research designed to discover the principles underlying behavior in practical situations. Instead of trying to replicate operational tasks, attempts are made to devise laboratory tasks which involve behavior categories thought to be important in a wide variety of operational situations. At this level even the "purest" of experimental psychologists may find research problems consistent with his belief in strict adherence to the scientific method.

Adequate coverage of the various problem areas under investigation by engineering psychologists is impossible in a brief survey of the field. Below are summarized three of those which have proven to be of particular interest.

The oldest and most extensively investigated area is that of the design and arrangement of instrument displays. These include dials, cathode ray tubes, and other types of presenters which provide informational input from the machine to the operator. The problems in this area call for the application of knowledge of man's perceptual processes and the conditions determining efficiency of perception. The great majority of machine displays present data visually. Most instrument dials fall into one or the other of three categories depending on the use to be made

of the information: (1) check instruments, providing "on-off" or "safe-danger" signals; (2) qualitative instruments, such as fuel gauges where precise reading is not required; (3) precise quantitative instruments (e. g., speedometers, altimeters, compasses) which have to be read rapidly and accurately. These last are the most common and obviously call for the most care in design. In one striking experiment it was found that experienced aircraft pilots misread the conventional altimeter by as much as 1,000 feet 12% of the time! Experimental studies are providing answers to such questions as: the best shape for a dial; the most legible numbering system and scale sizes for dials; the best location of "zero" on circular dials (e. g., at 3, 6, 9, or 12 o'clock); and the relative intelligibility of pointer-and-scale instruments as compared with direct-reading counters. Since machine displays are used to present many different types of information and their designs are capable of tremendous variation, it is easy to see that the investigator is faced with a multitude of hypotheses to test in the field of data presentation.

The location, discriminability, and a variety of manipulation characteristics of machine controls have been investigated in order to reduce error, combat fatigue, and generally increase efficiency of operation. Here the emphasis is on the human operator as a "link" between the displays and controls of the machine. Difficulties have arisen from such conditions as crowding of controls, the nonstandardization of control shapes and locations from one machine model to another (e. g., in aircraft and automobiles), awkward directions of control movements, and improper torques in control mechanisms. Investigators have found that the majority of persons have pronounced preferences for certain directions of control movements. For example, a toggle switch should flip *up* for ON, GO, or INCREASE, and *down* for OFF, STOP, or DECREASE. Such preferences have come to be known as "population stereotypes" in control design research (5). It has also been found that data displays best adapted to one type of response (e. g., rotating a control knob) are not necessarily the most efficient presenters for a radically different type of response (moving a joy stick, for example). This relationship has come to be known as "stimulus-response compatability" (6), and has led to a number of principles for properly matching machine displays and controls. Research efforts have also been made to combat errors arising from confusion of controls. These have led to various kinds of "control coding" in terms of shape, color, location, etc. As a striking example, Air Force psychologists were able to devise different shapes for control knobs which could be immediately discriminated by blindfolded operators, even with gloves on (9).

Extensive research has been concerned with factors determining human efficiency in *tracking*, a process of paramount importance in a

number of military operations. Tracking represents a special aspect of the concept of "stimulus-response compatability," since man (acting as a servo mechanism to make control adjustments based on data fed back through displays) applies force to the controls *intermittently* rather than *continuously*. Taylor and his associates at the Naval Research Laboratory have developed two principles which have greatly aided the accuracy of human performance in continuous tracking by redesigning control and display mechanisms (1). The first of these has the effect of relieving the man of the necessity of applying force continuously or in some time-sequenced pattern. This process of easing the human's task by reducing the required effort has been called "unburdening." The second principle, termed "quickening" was designed to provide the operator with immediate knowledge of the results of his own actions. Consider in the case of steering a large ship, the time lag between the helmsman's turning the wheel and the ship's response in heading into the new course. In nosing a ship through a very narrow space, as into a dock, this delay could lead the operator to "overcontrol" with consequent deviations, to the left and right of the desired path. Progress would be "jerky" at best, and danger of collision with obstacles would be great. In control mechanisms designed to provide the "quickening" aid to the operator, this delay between control movements and "feed-back" of information is eliminated. The installation of special mechanisms which display to the operator early information concerning the system output, enable him to make faster and smaller corrections. Experiments with actual tracking devices have established the marked superiority of performance achieved with the aid of "quickening."

Some of the other problems of current interest in human engineering are the following:

Comparison of the relative efficiency of the several sense organs (especially the eyes and ears). These senses are being compared as input channels for the reception of information. One of the questions under investigation in this area is whether it is more efficient to present all of the data through one sense channel or to distribute the information through several senses. If the latter is more advisable, are the different senses peculiarly adapted for specific purposes? Here the "stimulus-response compatability" concept is applied to the sensory input of information for purposes of communication. As an example, research at the University of Virginia has indicated that when persons are distracted by competing tasks, auditory input in the form of spoken words is more intelligible than printed messages (8, 9). Research is currently in progress on the exploration of the tactual and vibratory senses at potential channels for communication to relieve the eyes and ears which some engineers believe to be already overburdened. Geldard and his

associates at the University of Virginia, have developed a vibrotactile code which is now being tested by the Office of Naval Research for possible use in operational communication (7).

Factors determining the efficiency of operator performance of near-simultaneous multiple tasks. This problem would once have been called "divided attention." The efficiency with which a person can shift quickly back and forth among a number of competing tasks is a problem of paramount importance in modern control centers, both military and civilian.

Factors determining the efficiency of "decision-making." This problem is closely related to the last one, since "tasks" whether simple or complex, usually call for the operator's making a choice from among alternative responses on the basis of available data and his memory of preceding events. Considerable research, much of it at a rather basic level, is currently in progress on the complex processes involved in deciding on alternative courses of action.

Other areas of research, initiated by the Armed Forces, relate to the influence of extreme environmental conditions (e. g., heat, cold, high altitude, vibration), upon human performance. Closely associated are questions concerning the most efficient design of personal clothing and equipment.

One of the most intriguing questions confronting the human engineer is that of determining the relative efficiency of human beings and machines. Answers to this question are thus far more speculative than experimental, but there is tentative agreement that machines can be constructed that are superior to the human operator in speed, smoothness, and power of response (the autopilot is an example); in performing routine, repetitive tasks (since they are less susceptible to boredom or fatigue); in computation; in conducting simultaneous activities; and in short-term storage or "memory." Man appears superior to machines thus far devised in acuity of sensory discrimination; in recognition and interpretation; in flexibility or adaptability of judgment; in inductive reasoning; and in long-term memory.

In human engineering there is now discernible a distrinct trend away from "end item" research (e. g., the design of dials and control knobs) toward a more comprehensive investigation of the overall efficiency of teams of men and machines cooperatively involved in complex operations extending over great distances and long periods of time. This area of investigation is known as *systems research.* The work of Fitts at Ohio State on air traffic control, and that at the Rand Corporation, and on "Project Lincoln" at Massachusetts Institute of Technology (both on air defense), are examples. Teams of systems researchers, utilizing elec-

tronic simulators, can test typical operations for delays and errors, and can evaluate new procedures and equipment. The methodological difficulties encountered in systems research are probably the most formidable in all of human engineering.

The contributions of human engineering research have not been limited to solving the man-machine problems of the Armed Forces and private industry. As might have been expected, the basic research on the perceptual, intellectual, and motor capacities of the human has enriched experimental psychology as a pure science. For example, the practical problems, hypotheses, and experimental findings of man-machine operation are leading psychologists to take a "new look" at the old problem of *perception*. Emphasis is shifting away from the older description of how objects in the world appear in conscious experience, toward factors determining the efficiency of responses made to the various stimulus complexes which comprise the signals and messages of the man-machine world. Increasing recognition is being given to conditions within the human organism, as distinct from characteristics of the physical stimulus situation, as important determiners of perception. In place of the older emphasis on sensory discrimination, new problems of interpretation, retention, and judgment are considered critical aspects of the total process by which the human operator takes in and makes use of information from his environment. We now seem to be on the threshold of important basic research on these processes, frequently referred to by engineers as the "recoding" of stimulus data by the human operator. *Information Theory* has provided the experimental psychologist with a new technique for measuring the informational input of stimulus presentation and that of the subsequent responses made by the operator on the output side.

Especially significant in the area of sensory discrimination has been the recent finding that human capacity to make absolute sensory judgments is far more limited than had been suspected. Investigations have shown that in the identification of tones, loudnesses, taste intensities, visual extents, and tacto-vibrile qualities, successful absolute judgments are limited to a narrow range of from 4 to 12 steps, or in terms of *Information Theory*, to a range of from 2 to 3.5 "bits" of information. This limited capacity to identify specific stimuli is in striking contrast to the enormously greater differential sensitivity of the average human to the same stimuli. Miller has dramatically underlined the significance of these findings in a paper published in the *Psychological Review* (12).

The concept of "stimulus-response compatibility" has led to important new insights into the nature of motor skills. Pressing questions now waiting to be answered will doubtless lead to much needed investigation of the characteristics of human responses. Under the influence of the classical introspectionists, research in this very significant aspect of

psychology has lagged far behind experimentation on the sensory aspects of human behavior.

Where does human engineering research take place? Currently four widely divergent types of agencies are engaged in the investigation of problems in engineering psychology. These are military research laboratories; private commercial agencies, like the American Institute for Research, or Dunlap and Associates; industrial companies engaged in the development and manufacture of complex equipment, notably the aircraft companies; and in universities. Much of the university research in this field takes place under contracts supported by the Armed Services. Up to the present time human engineering research has been largely subsidized by the various national defense agencies. Private industry as exemplified by the Bell Telephone Laboratories, is coming to devote more efforts in this direction. Both federal and state agencies are today financing investigation of highway and automotive safety problems related to man-machine operation.

Will human engineering research be made obsolete within the next few years by *automation*? In the kaleidoscopic age in which we are now living long-range predictions are hazardous. But it seems unlikely that the human link in complex machine systems will be entirely eliminated for a long time to come. In this connection it should be noted that as more complex machines are built more and more maintenance is inevitably required. Furthermore, the last decade has seen the production of multitudes of machines and gadgets for operation by the average citizen. It can be predicted with some confidence that problems of man-machine operation and maintenance will remain with us long enough to require a considerable amount of human engineering research in the years immediately ahead.

REFERENCES

1. BIRMINGHAM, H. P., and TAYLOR, F. V. A human engineering approach to the design of man-operated continuous control systems. *NRL Report 4333, Naval Research Laboratory, Washington, April* 1954..

2. CHAPANIS, A., GARNER, W. R., and MORGAN, C. T. *Applied Experimental Psychology.* New York; *Wiley,* 1949.

3. Committee on Undersea Warfare. Human Factors in Undersea Warfare. *National Research Council,* Washington, 1949.

4. FITTS, P. M. (Ed.). Human engineering for an effective air navigation and traffic-control system. *Committee on Aviation Psychology, National Research Council,* Washington, March 1951.

5. FITTS, P. M., Engineering psychology and equipment design. In Stevens, S. S. (Ed.). *Handbook of Experimental Psychology*, N. Y.; *Wiley*, 1951.

6. FITTS, P. M., and SEEGAR, C. M. S-R compatibility: spatial characteristics of stimulus and response codes. *Jour. of Exp. Psychol.*, 46, 1953, 199-210.

7. GELDARD, F. A. Hearing through the skin. *Research Reviews*. Office of Naval Research, Washington, October 1954.

8. HENNEMAN, R. H. LEWIS, P., and MATTHEWS, T. L. Auditory and visual message presentation under distracting task conditions: I. The influence of the sensory requirements of the distracting task. *WADC Technical Report* 53-309, Wright Air Development Center, November 1953.

9. HENNEMAN, R. H., and MATTHEWS, T. L. Auditory and visual message presentation under distracting task conditions: II. The influence of message length and distracting task complexity. *WADC Technical Report* 54-145, Wright Air Development Center, July 1954.

10. Institute for Applied Experimental Psychology. *Handbook of Human Engineering Data*. Medford, Mass.; Tufts College, 1952.

11. JENKINS, W. O. Tactual discrimination of shapes for coding aircraft-type controls. In Fitts, P. M. (Ed.). *Psychological Research on Equipment Design*. Washington, U. S. Government Printing Office, 1947a.

12. MILLER, G. A. The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychol. Review*, 53, 1956, 81-97.

13. MOBRAY, G. H., Man as a link in complex machine systems. *Sci. Monthly*, 83, 1956, 269-276.

14. WARREN, N. D. Automation, human engineering, and psychology. *The Amer. Psychol.*, 11, 1956, 531-536.

A Comparison of the Blood Oxygen Capacity In The Black Crappie (Pomoxis nigromaculatus) And The Bluegill (Lepomis macrochirus)

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Blood oxygen capacity is a measure of the amount of oxygen present in blood when it is fully saturated with atmospheric oxygen. As used in the present investigation, the measurement is reported in volumes per cent. This is the number of milliters of oxygen that combines with 100 mls. of blood in a complete saturation state, and corrected to standard temperature and pressure.

Relatively little information is available in the literature concerning the oxygen capacity of the blood of vertebrates. Investigations in the past have been primarily concerned with mammals (Albritton, 1952; Burke, 1953). It is recognized that in the various vertebrate classes homoiotherms have, in general, a higher blood oxygen capacity than do poikilotherms. Also, the oxygen capacity of the blood varies within individual species as well as among species (Prosser *et al.* 1950; Hoar *et al.* 1951; and Burke, 1953).

Inasmuch as most fishes are subjected to comparatively narrow tolerance limits within their environment, they present problems of ecological interest as related to physiological demands. Among these limiting factors, oxygen plays a primary role since a steady state of equilibrium must be maintained in respiration. It is the dissolved oxygen in the water that is transported by the blood hemoglobin for respiratory function.

The black crappie (*Pomoxis nigromaculatus*) and the bluegill (*Lepomis macrochirus*) were used as experimental animals because of their availability, size, family relationship, and utilization of the same habitat. Specimens were collected in Westhampton Lake and its drainage from April through August, 1956. The one-hundred year old, artificial lake is located on the campus of the University of Richmond, Richmond, Virginia. Its water source is Westham Creek at the north end, run-off surface water, and several springs within the lake. It is surrounded by woods except at the south end where it drains to the James River which

is approximately one mile away. Lying on a northwest, southeast axis, the lake is about 15 ft. deep near the center line, 1700 ft. long, and 500 ft. wide. The bottom is sand, and has been subjected to heavy silting which has necessitated periodic draining and dredging.

METHODS AND MATERIALS

The microgasometric syringe method described by Roughton and Scholander (1943) and modified by Grant (1947) was used to determine the blood oxygen capacity of twenty bluegills and twenty crappies. The syringe method, which utilizes only 39.3 cmm. of blood, is particularly adaptable to the study of blood oxygen capacity in small animals.

Carefully, and without loss of time, blood was removed from the fish in the following manner: a ventral, abdominal incision was made exposing the heart; the ventricle clipped; blood sucked into a pipette; and transferred immediately into the syringe. Immediate transfer was necessary as the blood coagulated within thirty seconds or less. This is in keeping with the findings of Saito (1954) who reported that, in the blood of fishes he studied, coagulation occurred in one minute or less.

Data pertaining to the blood oxygen capacity determinations were recorded. Each fish was weighed to the nearest gram, standard length (from snout tip to the hypural plate) measured in millimeters, and the sex and gonad condition noted. The oxygen content of the water was determined by the Alsterberg modification of the Winkler Method (A.P.-H.A. 1946, Standard Methods). The specimens were taken from water which ranged in dissolved oxygen values from 6.3 to 10.0 ppm.

Collections were made with a 10 ft., one-quarter inch seine, and by angling. Individual specimens were immediately transported to the laboratory, placed in tanks with running water, and samples then run. Air and water temperature recordings were made at the time of collec-

Table I. Abbreviations used denote the following:

gm.	=	body weight in grams
mm.	=	standard length in millimeters
O. C.	=	blood oxygen capacity in volumes per cent
S. D.	=	standard deviation of the blood oxygen capacity
S. E. m	=	standard error of the mean of the blood oxygen capacity
A. D. m	=	arithmetic difference of the mean blood oxygen capacity between males and females
S. E. d	=	standard error of the difference between the two mean oxygen capacities in males and females

Table I

Pomoxis nigromaculatus

No.	Wt. (gm.)	Std. lg. (mm)	Condition of gonads	Blood O. C. (Vol. %)
		FEMALE		
1	57	124	mature	9.6
2	60	135	mature	9.6
3	141	160	mature	8.0
4	88	138	mature	8.4
5	52	123	mature	7.1
6	84	143	ripe	8.3
7	63	132	ripe	7.9
8	57	123	ripe	8.7
9	84	146	ripe	8.8
10	60	128	ripe	7.9
Mean	75	135	—	8.4
S. D.	—	—	—	0.74
S. E. m	—	—	—	0.23
		MALE		
1	53	123	mature	8.7
2	86	123	immature	8.9
3	108	153	mature	7.6
4	68	132	ripe	7.5
5	57	126	ripe	8.8
6	61	126	ripe	7.9
7	45	118	ripe	8.7
8	58	121	ripe	9.7
9	73	136	ripe	8.4
10	53	125	spent	8.4
Mean	66	128	—	8.5
S. D.	—	—	—	0.63
S. E. m	—	—	—	0.20
A. D. m	—	—	—	0.10
S. E. d	—	—	—	0.31
(S. E. d x 3)		—	—	0.93
TOTAL	SAMPLE			
Mean	71	132	—	8.5
S. D.	—	—	—	0.69
S. E. m	—	—	—	0.15

Table II

Lepomis macrochirus

No.	Wt. (gm.)	Std. lg. (mm)	Condition of gonads	Blood O. C. (Vol. %)
FEMALE				
1	99	136	mature	7.9
2	86	145	mature	6.0
3	90	137	immature	7.7
4	69	125	immature	8.1
5	56	122	immature	8.1
6	91	141	immature	7.8
7	65	120	immature	6.8
8	62	122	immature	7.3
9	65	118	immature	8.4
10	56	114		6.3
Mean	74	128	—	7.4
S. D.	—	—	—	0.78
S. E. m	—	—	—	0.24
MALE				
1	130	142	mature	7.7
2	111	145	mature	6.9
3	113	142	immature	6.8
4	90	138	immature	7.7
5	95	140	immature	8.5
6	72	122	immature	7.3
7	78	132	immature	6.8
8	91	136	immature	6.3
9	101	146	immature	7.2
10	90	133	immature	8.4
Mean	97	138	—	7.4
S. D.	—	—	—	0.68
S. E. m	—	—	—	0.21
A. D. m	—	—	—	0
S. E. d	—	—	—	0.33
S. E. D. x 3		—	—	0.99
TOTAL	SAMPLE			
Mean	86	133	—	7.4
S. D.	—	—	—	0.73
S. E. m	—	—	—	0.16

Table II. Abbreviations have the same meaning as in Table I.

tion. Air temperatures ranged from 48° to 81° F., and water temperatures from 53° to 84° F.

Statistical analyses concerning differences in sexes, differences between species, and relationship of blood oxygen capacity to body weight and standard length follow Simpson and Roe (1939), and Arkin and Colton (1950).

RESULTS

Data are presented in Tables I and II for twenty specimens each of black crappie and bluegill. They had a mean body weight of 71 and 86 gm., a mean standard length of 132 and 133 mm., and a mean blood oxygen capacity of 8.5 and 7.4 volumes per cent, respectively. Each sample consisted of ten males and ten females with gonadal condition ranging from immature to spent in the crappie, and immature to mature in the bluegill. The standard deviation and the standard error of the mean of blood oxygen capacities were as follows: black crappie = 0.69 and 0.15 volumes per cent; bluegill = 0.73 and 0.16 volumes per cent. Statistics, including significance tests, were tabulated for males and females of each species; these showed no positive sex correlation.

Graphical presentation of the relationship of blood oxygen capacity in volumes per cent per gram of body weight to an increase in body weight for the black crappie and bluegill is given in Figure 1.

DISCUSSION OF RESULTS

As shown in Tables I and II, the blood oxygen capacity value is 1.1 volumes per cent higher in the black crappie than in the bluegill. When treated statistically, using the standard error of the difference between two means, it was found that the difference was significant and not due to chance although the fishes are in the same family, occupy the same habitat, and are of approximately the same age, weight, and length. The significance is evident as the actual difference between the means is greater than three times the standard error of the difference between the means: (3 x 0.23 = 0.69). When these statistics are plotted, as in Figure 1, the oxygen capacity values for the black crappie tend to shift to the left of those for the bluegill. Whether this difference is entirely genetic, or related directly to environmental factors, or both, is problematic at present. However, future investigations should provide answers that can be correlated with the data presented here.

It has been reported in mammals such as albino rats (*Rattus norvegicus*) (Burke, 1957), that the blood oxygen capacity per unit of body weight decreases as the unit of body weight increases. This con-

dition of relationship was also found to exist in the crappie and in the bluegill. Reference to Figure 1 shows that as the body weight increases the blood oxygen capacity per gram of body weight decreases. A similar relationship is shown to exist in fish blood volume studies by Martin (1950). These two factors may reflect a lowering of metabolism in larger fish inasmuch as mammalian blood studies can be correlated to show this relationship (Pearson, 1948; Burke, 1954). It is conceivable, then, that fish of a lesser weight may utilize available oxygen to a better metabolic advantage than fish of a greater weight. Although fishes of approximately the same weight were used so that a comparison could be made between species, an indication of an increase in oxygen capacity with an increase in body weight was noted. This characteristic has also been shown to be true of mammals (Burke, 1957).

Apparently blood oxygen capacity in either the black crappie or bluegill is not affected by the conditions of the gonads. Also, there was

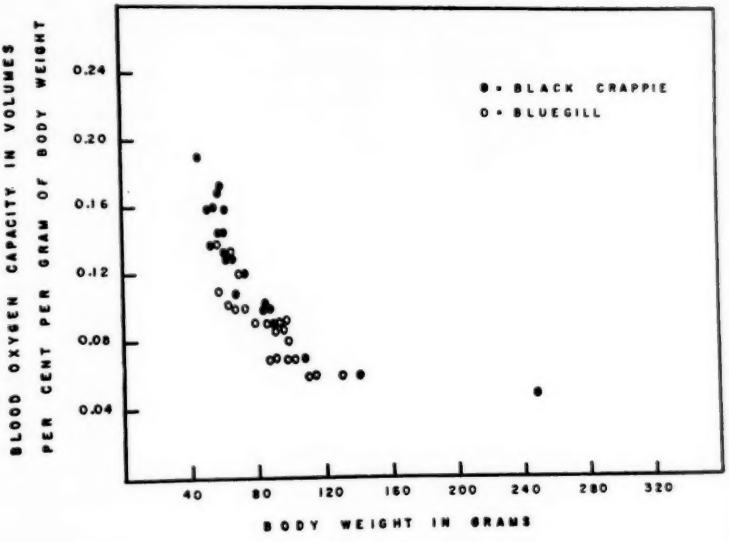

Figure 1. The relationship of blood oxygen capacity in volumes per cent per gram of body weight to an increase in body weight for the black crappie and the bluegill. Included is a 247 gm. specimen of black crappie not shown in the data in Table I.

no evidence of sexual dimorphism in regard to the relationship of this character to body weight or to standard length as shown by the statistical treatments in Tables I and II.

SUMMARY

1. The microgasometric syringe method was used since it is adaptable to the study of the oxygen capacity of blood in small fish as only 39.3 cmm. of blood is necessary for a sample.

2. Coagulation of blood occurred in the black crappie and the bluegill in thirty seconds or less.

3. The black crappie and the bluegill had a mean body weight of 71 and 86 gm.; a mean standard length of 132 and 133 mm., and a mean blood oxygen capacity of 8.5 and 7.4 volumes per cent, respectively.

4. Statistically, a significant difference existed between the species in reference to their blood oxygen capacity. This may indicate a character of importance in the study of the taxonomy of fishes.

5. The data show that as the body weight increases the oxygen capacity of the blood per gram of body weight decreases.

6. Results indicate the oxygen capacity of the blood increases as body weight increases.

7. Apparently, blood oxygen capacity was not influenced by either sex or gonad condition.

ACKNOWLEDGMENTS

Appreciation is expressed to our wives for their help in the preparation of the graph and the typing of the manuscript. Thanks are also given to our colleagues in the Department of Biology, University of Richmond for their critical reading of the manuscript: Dr. Robert F. Smart; Dr. J. C. Strickland; Dr. Nolan E. Rice; and Dr. W. R. West, Jr.

LITERATURE CITED

ALBRITTON, E. C. (Editor) 1952. Standard Values in Blood. *W. B. Saunders Co.*, Philadelphia.

AMERICAN PUBLIC HEALTH ASSOCIATION 1946. Standard Methods for the Examination of Water and Sewage. 9th Ed., *A.P.H.A.*, N. Y.

ARKIN, H., and R. R. COLTON. 1950. An Outline of Statistical Methods. *Barnes and Noble*, N. Y.

BURKE, J. D. 1953. Oxygen Capacity in Mammals. *Psysiol. Zool.*, 26: 259-266.

BURKE, J. D. 1954. Blood Volume in Mammals. *Physiol. Zool.*, 27: 1-21.

BURKE, J. D. (1957). Blood Oxygen Capacity of Albino Rats. *Amer. J. Physiol.* 188:118-120.

GRANT, W. C. 1947. Determination of Oxygen Capacity on 39.3 cmm. of Blood. *Proc. Exper. Biol. and Med.*, 66: 60-62.

HOAR, W. S., V. S. BLACK, and E. C. BLACK. 1951. Some Aspects of the Physiology of Fish. No. 59., *University of Toronto Press.*

MARTIN, A. W. 1950. Some Remarks on the Blood Volume of Fish. In Studies Honoring Trevor Kincaid. *University of Washington Press.*

PEARSON, O. P. 1948. Metabolism of Small Mammals, with Remarks on the Lower Limit of Mammalian Size. *Science*, 108: 44.

PROSSER, C. L. (Editor), D. W. BISHOP, F. A. BROWN, JR., T. L. JAHN, and V. J. WULFF. 1950. Comparative Animal Physiology. *W. B. Saunders Co.*, Philadelphia.

ROUGHTON, F. J. W., and P. F. SCHOLANDER. 1943. The Microdetermination of Blood Gases. I. Oxygen. *Jour. Biol. Chem.*, 148: 541-550.

SAITO, K. 1954. Biochemical Studies on Fish Blood. II. On the Elements of Blood Coagulation and Coagulation Time. *Bull. Japanese Soc. Sci. Fish.*, 19: 1139-1143.

SIMPSON, G. G., and ANNE ROE. 1939. Quantitative Zoology. *McGraw-Hill*, N. Y.

The Sex Bivalent of the Chinese Hamster, (Cricetulus Griseus)

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The Syrian or golden hamster, *Mesocricetus auratus*, is a well known laboratory animal but the related Chinese hamster, *Cricetulus griseus*, has been domesticated for a shorter time and its cytogenetic possibilities only recently made clear (Yerganian, 1952). This hamster was first mentioned by Hsieh (1919), and first examined cytologically by Pontecorvo (1943). Pontecorvo, working with testicular material which had been fixed and stored for several years, reported a mitotic chromosome number of 14 and described the sex chromosomes as the largest pair. His figures depict both symmetrical and asymmetrical sex bivalents apparently identical with those of *Mesocricetus auratus* previously described by Koller (1938).

Matthey (1951, 1952), was unable to confirm the chromosome number determination of Pontecorvo, and reported 22 as the mitotic number in *Cricetulus griseus*. He agrees with Pontecorvo's conclusion that the longest chromosomes constitute the X-Y bivalent. This is described, however, as undergoing prereduction only, contrary to the observations of Pontecorvo.

In a study of *Cricetulus griseus*, *Cricetus cricetus*, and *Mesocricetus auratus*, Sachs (1952) reports 22 chromosomes in *C. griseus* and *C. cricetus* thereby confirming Matthey's determination. He does not describe the sex chromosomes.

Yerganian (1953, 1955) has studied the mitotic chromosomes of *C. griseus* in some detail and describes them as follows: " . . . . four large – to – medium sized metacentric or V-shaped pairs, three small metacentric pairs, one large J-shaped pair, and three medium sized subtelocentric or I-shaped pairs." On the basis of an X-ray induced reciprocal translocation involving one of the largest and one of the smallest chromosomes, he takes exception to the conclusion of Pontecorvo and Matthey that the largest pair are sex chromosomes and states that "the corresponding male and female mitotic homologues are morphologically similar. Consequently the sex chromosomes remain unidentified."

Although the chromosome number of the Chinese hamster has been determined by Matthey, Sachs, and Yerganian, there is disagreement with respect to the chromosomes which constitute the X-Y bivalent. It has seemed necessary to clarify the situation by further study. This has

been done; it is now apparent that the submedianly constricted pair of chromosomes, one of which is nearly subterminally constricted at mitotic metaphase in the male, are the chromosomes associated with sex.

The testes of three adult males[1] were fixed immediately upon removal in acetic-alcohol (1:3), acetic-alcohol-chloroform (1:6:3) or the fixative of San Felice. Temporary preparations were stained with aceto-carmine after the method of Painter (1939). The material fixed in San Felice's solution was stained by means of the Feulgen reaction, embedded in paraffin, and sectioned at 20 μ. The squash preparations, especially after fixation in acetic-alcohol-chloroform, were so superior to the sectioned material that they were used exclusively. Final observations were made with a Zeiss microscope using 90x, n.a. 1.3 and 1.4 oil immersion objectives, and 7x, 15x, and 20x oculars. All drawings and measurements were made with a camera lucida.

The chromosomes of spermatogonial cells, fixed in acetic-alcohol-chloroform without pretreatment and stored immediately at 5°C., vary in length depending upon the degree of spindle formation and the completion of congression. At late prophase and prometaphase, when pressure upon the coverglass will spread the chromosomes, they measure from 9.8–1.5 μ in length (Fig. 1). The five largest pairs are submedianly constricted; the longest chromosomes are 9.8 μ in length and the shortest are 4.3 μ. The three smallest pairs are medianly or submedianly constricted and measure approximately 1.5 μ. The remaining three pairs are subterminally constricted; the largest are 3.7 μ and the smallest slightly over 3 μ.

When the spindle is completely formed and the chromosomes have assumed the late metaphase position, they have decreased 30-50 percent in length and their position is seldom if ever altered by pressure upon the coverglass (Fig. 8). The largest of the submedianly constricted chromosomes are 5.6 μ in length and the smallest 2.8 μ. The smallest chromosomes are now 0.9 – 1 μ in length and the subterminally constricted ones 1.5 – 2 μ.

The chromosomes of eight spermatogonial cells are arranged in order of decreasing length in Figs. 1-8. The largest chromosomes are all submedianly constricted. With the exception of one pair, the homologous arms, when foreshortening is allowed for, are identical in length. The

(1) These were among several kindly furnished by Mr. G. Yerganian of the Children's Cancer Research Foundation, Boston. We are indebted to him for them and for helpful suggestions.

members of the exceptional pair, which is shown in outline, are unequal in size. The size difference is confined to the shorter arms. The centromere of the shorter chromosome is sufficiently far from the median position in Figs. 1, 3, 5, 6, and 8 to present a problem in terminology. Here it may as easily be considered subterminally constricted as submedianly. The short arm of the longer chromosome is 0.3 – 1 μ longer than the short arm of the shorter. This difference is small in terms of micra but it is easily detected in our preparations. It represents 6-10 percent of the length of the longer chromosome which we assume to be the X. The contraction of this heteromorphic pair between the late prophase and late metaphase is more extreme (at least 10 percent greater) than any of the other chromosomes. At the earlier stages (Figs. 1-4) it is seen as the third longest. At later stages (Figs. 5-7) it is the fourth longest and at late metaphase the three smaller submedianly constricted pairs are nearly identical in size (Fig. 8). The diameter of the X and the smaller member of the heteromorphic pair, the Y, is slightly less than the diameter of the other chromosomes of comparable size. At late metaphase the X and Y are smoother in outline and may be described in some preparations as appearing "overfixed." In Figs. 3-7 a larger unstained region is seen at the centromere in one or both of these chromosomes than is found in any of the other pairs.

The heteromorphic pair is probably the "large J-shaped pair" mentioned by Yerganian (1955). The two lowermost chromosomes in Plate 1, Figure 5 of Sachs (1952) may be the unequal pair described here.

At metaphase-anaphase of meiosis I the heteromorphic bivalent may be recognized by its less intense staining, the submedian position of its centromeres, and the invariable association of the attenuated shorter arms (Figs. 9-11). The Y-chromosome shows somewhat less intense staining than the autosomes, and the X-chromosomes less intense staining than the Y. The X-chromosome is frequently more loosely coiled. Occasionally plasmasomal material is associated with a portion of this bivalent (Figs. 15, 22). The long arms of the X and Y may be associated as well as the short arms (Figs. 18, 20, 31 and 37). The ring configurations reveal the submedian position of the centromeres especially well.

Figures 19-21 suggest strongly that the short arms of the X and Y are associated by a chiasma which will lead to the equational separation of a short differential segment. Figure 23 also supports this conclusion. The X-and Y-chromosome, as seen at mitotic metaphase, have short arms of unequal length; these are the arms that are invariably associated at metaphase I. The occurrence of a chiasma demands the symmetrical separation of the X and Y.

When the chromosomes have reached the poles at anaphase, the X-

chromosome remains more loosely coiled, and, except for a portion of its shorter arm, is less deeply colored by the aceto-carmine than are the autosomes. The Y-chromosome, however, decreases in size and becomes indistinguishable from the autosomes with respect to degree of staining (Figs. 26-30, 32-36).

It is clear that the chromosome we have called the Y is subterminally constricted or nearly so. The short arm is bent backward toward the attenuated short arm of the X. This is additional evidence that these arms are associated earlier, for the three pairs of subterminally constricted autosomes present a different appearance. As they separate the short arms are pushed in front of the centromeres and lead the way to the poles unless they have been earlier associated as ring bivalents (Fig. 10).

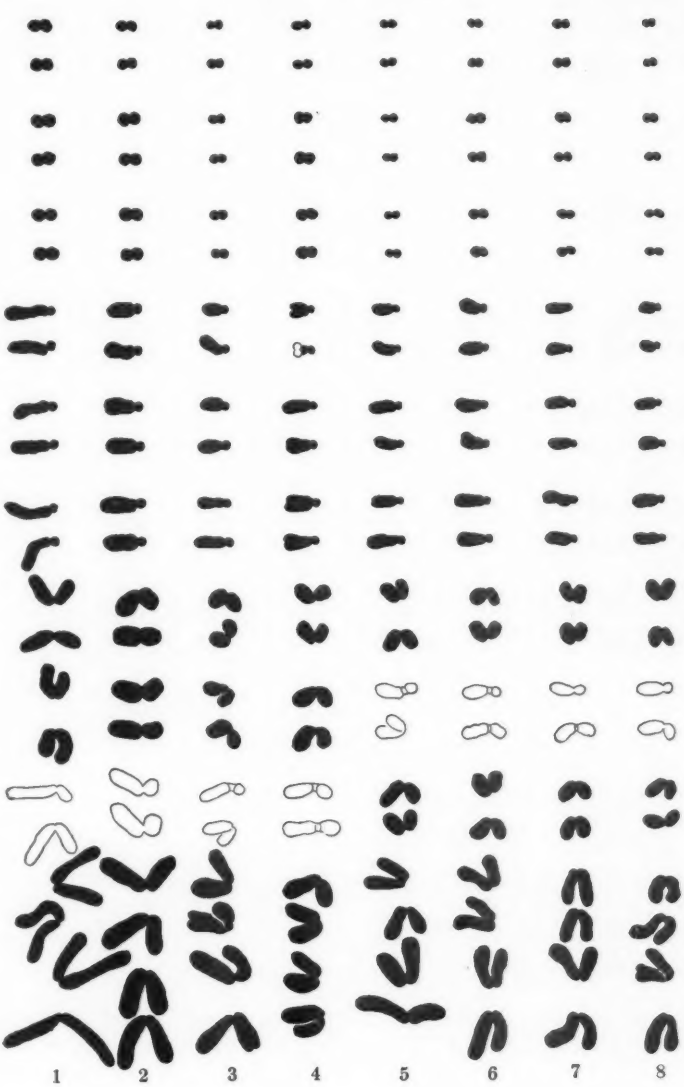
In a portion of the testes of one animal, several ring bivalents were found at metaphase which are identical to the symmetrical sex bivalent of the Syrian hamster as described and figured by Koller (1938). These had an elongated, light staining segment which arose from the shorter arms (Fig. 37).

The sex chromosomes of the Chinese hamster and the Syrian hamster appear to be structurally alike. The short arm of the X-chromosome of the Syrian hamster is 0.6 μ longer than the short arm of the Y at mitotic metaphase. This difference in length represents approximately 7 percent of the length of the entire X-chromosome (Sheaffer, 1954). In the Chinese hamster the difference in length is 0.3 — 1 μ, or 6-10 percent of the X-chromosome. The sex chromosomes of the Syrian hamster, however, are usually associated by chiasmata between their long arms which results in an asymmetrical bivalent and prereduction. They are less frequently associated by chiasmata between both the long and short arms giving rise to a symmetrical bivalent and the equational separation of the differential segment at anaphase I. In the Chinese hamster the sex chromosomes may be associated by chiasmata between the long as well as the short arms, although the most frequently encountered association is between short arms only, resulting in a symmetrical bivalent. An asymmetrical bivalent has not been seen in our material.

A more detailed study of the chromosomes of *Cricetus cricetus* and *Mesocricetus auratus* may furnish additional support for the interesting proposal of Sachs (1952) that *Mesocricetus auratus* is a polyploid species derived from *Cricetus cricetus* and *Cricetulus griseus*.

LEGENDS FOR TEXT FIGURES 1-37

Figures 1-8. The chromosomes of *Cricetulus griseus* from 8 spermatogonial cells. The X- and Y-chromosomes are shown in outline X 2166.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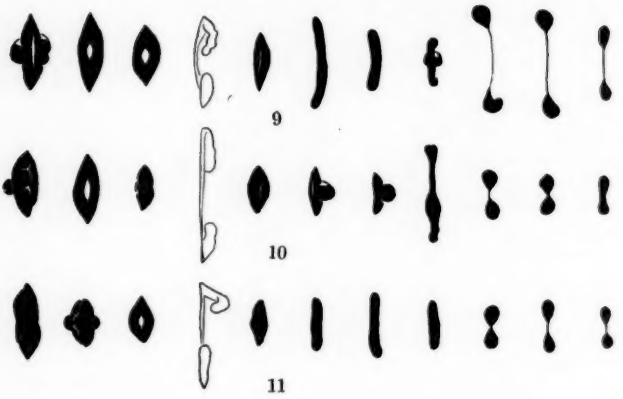
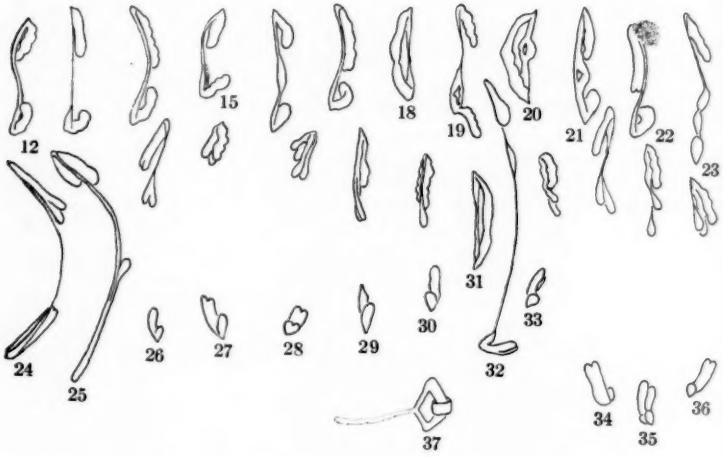


Figures 9-11. Meiotic metaphase – anaphase I. The sex bivalent is shown in outline. X 1666.



Figures 12-37. Twenty six pairs of sex chromosomes at metaphase I and anaphase I. Figs. 12-25, 31, and 37. Metaphase – anaphase; Figs. 26-20, 32-36. Late anaphase. X 1666.

SUMMARY

The Chinese hamster, *Cricetulus griseus*, has 22 chromosomes. The sex chromosomes are the third largest pair at late prophase and prometaphase of spermatogonial divisions. As the chromosomes decrease in length they become the fourth largest pair and at late metaphase cannot be distinguished by size alone from the smaller of the large submedianly constricted pairs. The short arm of the Y is shorter than the short arm of the X. The difference represents 6-10 percent of the length of the X-chromosome. In the male the X and Y are found as rod-, and less frequently as ring-bivalents. All the rod-bivalents are associated by their shorter, heteromorphic arms.

LITERATURE CITED

HSIEH, E. T. 1919. A New Laboratory Animal, *Cricetulus griseus*. *Nat. Med. J. China.* 5:20.

KOLLER, P. C. 1938. The Genetical and Mechanical Properties of the Sex-Chromosomes. IV. The Golden Hamster. *Jour. Genet.* 36:177-195.

MATTHEY, *R.* 1951. Les Chromosomes des Muridae. *Experientia* 7:340.

———— 1952. Chromosomes de Muridae. *Chromosoma* 5:113-138.

PAINTER, T. S. 1939. An Aceto-Carmine Method for Bird and Mammalian Chromosomes. *Science* 90:307-308.

PONTECORVO, G. 1943. Meiosis in the Striped Hamster (*Cricetulus griseus* Milne-Edw.) and the Problem of Heterochromatin in Mammalian Sex-Chromosomes. *Proc. Roy. Soc. B.* 62:32-42.

SACHS, LEO. 1952. Polyploid Evolution and Mammalian Chromosomes. *Heredity* 6:357-364.

SHEAFFER, CHARLES I. 1954. The X-Bivalent of the Golden Hamster. *The Virginia Journal of Science* 6:46-52.

YERGANIAN, G. 1952. Cytogenetic Possibilities with the Chinese Hamster, *Cricetulus barabensis griseus*. *Genetics* 37:638-639.

———— 1953. Evidence disclosing the autosomal nature of sex-chromosomes previously reported in the Chinese hamster, *Cricetulus griseus*. *Genetics.* 38:703-704.

———— 1955. Cytological features of a transplantable sarcoma induced in the Chinese hamster, *Cricetulus griseus*. *Proc. Am. Asso. Cancer Res.* 2:56.

Checklist of Oribatoid Mites in the Vicinity of Mountain Lake Biological Station - Virginia

(*Acarina, Oribatei*)[1]

Howard George Sengbusch[2]

This list of oribatoid mites is based upon observations and collections made during the summers of 1955 and 1956 in the vicinity of the Mountain Lake Biological Station, Giles County, Virginia. Since no checklist has been compiled up until now, this information is incomplete and should be considered only as a preliminary report.

The major collecting sites are indicated on the map (Fig. 1) which encompasses an area of approximately fifteen and one half square miles surrounding the Biological Station. The sites contain varied ecological niches in which the hygrophilous, so-called "moss mites" can be found. The habitats range from a thin layer of green algae growing in the twilight zone of Tawney's Cave (elevation 1900') to moss growing in crevices of exposed rock on Bald Knob (elevation 4368'), and from leaf litter at Wind Rock to lichens on the upper branches of oak trees near the Station.

The mites, which were collected by means of a modified Tullgren funnel (Sengbusch, 1951) were mounted on slides and examined. There is no key published in this country that is even approximately complete for the identification of these mites. However, Baker and Wharton (1952) have presented a key to, and synopsis of, the oribatoid mite families of the world and this key was followed by the author in compiling the checklist. The genera are listed in the sequence followed by Baker and Wharton (1952) with only a few minor exceptions. New species will be reported in a subsequent paper. The letters following the biotypes in which each of the species was found refer to the collecting sites on the map (Fig. 1) in this manner: A-Old West Virginia Road near Station; B-Pipeline leading into Station; C-Oak trees near entrance to Station; D-Wind Rock; E-Vicinity of Lakeside Club; F-Bald Knob; G-Cascades; H-Mann's Bog; I-Little Stoney Creek; J-Tawney's Cave Entrance; K-Tawney's Cave Exit.

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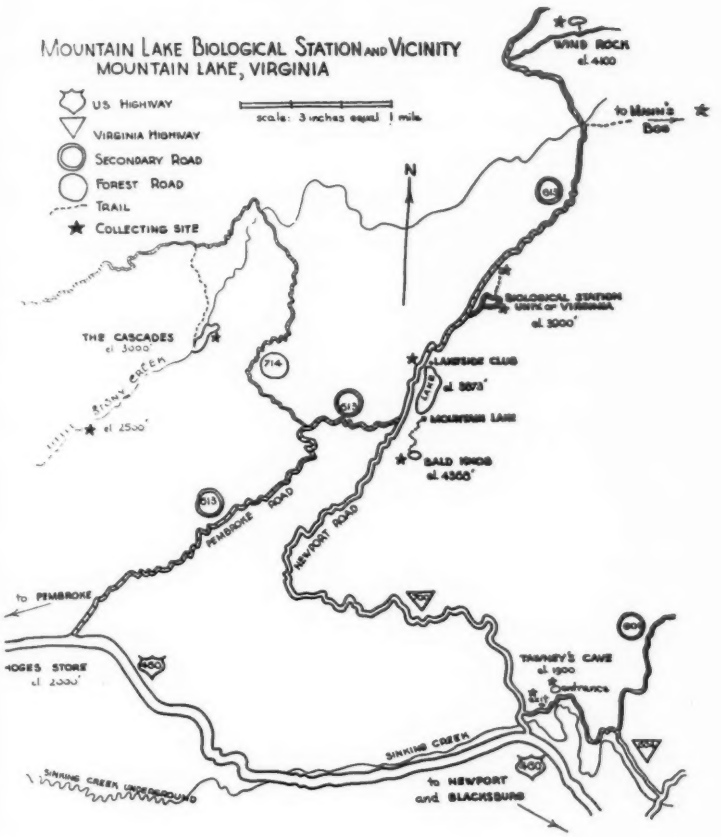
[1] Contribution of the Mountain Lake Biological Station of the University of Virginia.

[2] State University of New York, College for Teachers, Buffalo.



ANNOTATED LIST

Order Acari Leach 1817
Suborder Sarcoptiformes Reuter 1909
Supercohors Oribatei Duges 1833
Cohors Aptyctima Oudemans 1906

Family Palaeacaridae Grandjean, 1932
1. *Acaronychus sp.* (deutonymph) — Leaf litter-D.

Family Nanhermanniidae Sellnick, 1924
1. *Nanhermanannia nana* Nicholet, 1855 — Moss and lichens on white oak-C.

Family Hypochthoniidae Berlese, 1910
1. *Hypochthonius rufulus* C. L. Koch, 1835 — Moss — E; Leaf litter-D, J, K.
2. *Cosmochthonius lanatus* (Michael, 1885) — Algae, twilight zone-K.
3. *Eniochthonius grandjeani* (Michael, 1888) — Leaf litter D, J.
4. *Eobrachychthonius sexnotatus* Jacot, 1936 — Leaf litter — D. J; Moss-I.
5. *Trhypochthoniellus excavatus* (Willmann, 1919) — Very wet moss-A, G.

Family Malaconothridae Berlese, 1916
1. *Trimalaconothrus glaber* Michael, 1888 — Very wet moss-A.

Family Camisiidae Sellnick, 1928
1. *Camisia segnis* (Hermann, 1804) — Lichens on red oak-C.
2. *Camisia horrida* (Hermann, 1804) — Forest litter-K.
3. *Camisia spinifer* (C. L. Koch, 1835) — Wet sphagnum-H.
4. *Nothrus pratensis* Sellnick, 1928 — Wet decaying leaves-J.
5. *Nothrus rugulosus* Banks,, 1895 — Leaf litter-J.
6. *Nothrus silvestris* Nicolet, 1855 — Forest litter-J.
7. *Platynothrus peltifer* (C. L. Koch, 1839) — Wet moss-A, G.

Family Hermanniidae Sellnick, 1928
1. *Hermannia scabra* (L. Koch, 1879) — Moss-E, F.
2. *Hermannia convexa* (C. L. Koch, 1840) — Leaf litter-J.

Family Cymbaeremaeidae Willmann, 1931
1. *Scapheremaeus sp.* — Moss in crevice of rock-F.

Family Belbidae Willmann, 1931
1. *Belba articola* Hammer, 1952 — Wet leaves and moss-D. I.
2. *Belba tatrica* (Kulczynski, 1902) — Wet decaying leaves-D.
3. *Metabelba cremersi* Van der Hammen, 1952 — Wet moss-I.
4. *Metabelba pulverulenta* (C. L. Koch, 1840) — Algae, twilight zone-K; Moss-I; Leaf litter-J.

Family Eremaeidae Willmann, 1931
1. *Eremaeus columbianus* Berlese, 1884 — Lichens on red oak-B, C; Moss-I.
2. *Eremaeus oblongus* C. L. Koch, 1836 — Lichens on red oak-C; Moss-G, I.

3. *Eremaeus quadrilamellatus* Hammer, 1952 — Leaf litter-D; Moss-I.
4. *Ceratoppia bipilis* (Hermann, 1804) — Leaf litter-D; Wet moss-I.
5. *Oppia nitens* C. L. Koch, 1836 — Moss-E, G, I.
6. *Oppia nova* (Oudemans, 1902) — Lichens on white oak-C; Moss-A, I; Wet leaf litter-D.
7. *Oppia quadricarinata* (Michael, 1885) — Moss-G; lichen on white oak-C; algae, twilight zone-K.
8. *Oppia unicarinata* (Paoli, 1908) — Moss-F, I.
9. *Oribella crosbyi* Berlese, 1908 — Wet leaves in small cave-D.
10. *Peloppia serrata* Sellnick, 1931 — Leaf litter-K; lichens on white oak-C.
11. *Suctobelba sarakensis* Forsslund, 1941 — Moss on rock-F.
12. *Suctobelba sp* — Partially digested in gut of earthworm (*Bimastos zetecki* Smith and Gittens, 1915).
13. *Tricheremaeus pilosus* (Michael, 1888) — Lichens on red and white oaks-B, C; moss-G.

Family Carabodidae Willmann, 1931

1. *Carabodes coriaceous* C. L. Koch, 1836 — Wet leaves and moss-K.
2. *Carabodes areolatus* Berlese, 1916 — Lichens on red and black oaks-B, C; moss-G.
3. *Carabodes minusculus* Berlese, 1923 — Moss-E, F.
4. *Carabodes niger* Banks, 1895 — Moss-F.
5. *Scutovertex sp.* — Lichens on red oak-C.
6. *Tectocepheus velatus* (Michael, 1880) — Lichens on red oak-C; wet moss-G, I.
7. *Tectocepheus minor* Berlese, 1903 — Wet moss-A, E, I.

Family Hermanniellidae Grandjean, 1934

1. *Hermanniella granulata* (Nicolet, 1855) — Very wet moss-I.
2. *Hermanniella punctulata* Berlese, 1908 — Leaf litter-J.

Family Liacaridae Willmann, 1931

1. *Liacarus carolinensis* Banks, 1906 — Leaf litter-D, J, K.
2. *Liacarus subterraneus* (C. L. Koch, 1841) — Wet moss-I.
3. *Liacarus nitens* (Gervais, 1844) — Leaf litter-J.

Family Oribatulidae Jacot, 1929

1. *Oribatula tibialis* (Nicolet, 1855) — Wet moss-E, F, I.
2. *Oribatula minuta* (Ewing, 1909) — Wet moss-F, I.
3. *Oribatula pallidula* (Ewing, 1909) — Wet moss-G; lichens on black

oak-B.

4. *Zygoribatula exilis* (Nicolet, 1855) — Moss-E, G; lichens on red and black oaks-B, C.
5. *Liebstadia humerata* Sellnick, 1928 — Wet moss-G.
6. *Liebstadia sp.* — Moss-E.
7. *Protoschelobates seghetti* Runkel and Kates, 1947 — Leaf litter-D; moss-F.
8. *Scheloribates latipes* (C. L. Koch, 1841) — Wet moss-A; lichens on red oak-C.
9. *Scheloribates pallidulus* (C. L. Koch, 1841) — Moss-F; algae in twilight zone-K.

Family Ceratozetidae Jacot, 1925

1. *Ceratozetes gracilis* (Michael, 1884) — Moss-E.
2. *Ceratozetes mediocris* Berlese, 1908 — Wet moss-I; lichens on white oak-C.
3. *Chamobates cuspidatus* (Michael, 1884) — Lichens on black oak-B.
4. *Chamobates schutzi* (Oudemans, 1901) — Wet moss-I; leaf litter-K.
5. *Hammeria canadensis* Hammer, 1952 — Lichens on black oak-B; moss-F.
6. *Hammeria sp.* — Moss-F.
7. *Limnozetes canadensis* Hammer, 1952 — Wet moss-F, G.
8. *Mycobates tridactylus* Willmann, 1929 — Very wet moss-I.
9. *Sphaerozetes arcticus* Hammer, 1952 — Very wet moss-I.
10. *Punctoribates punctum* (C. L. Koch, 1839) — Very wet moss-A, I.
11. *Trichoribates copperminensis* Hammer, 1952 — wet moss-G.
12. *Trichoribates novus* (Sellnick, 1928) — Very wet moss-G.

Family Oribatellidae Jacot, 1925

1. *Oribatella quadricornuta* (Michael, 1884) — Leaf litter-K; moss-G.
2. *Oribatella minuta* Banks, 1896 — Lichens on red oaks-B, C.
3. *Oribatella sexdentata* Berlese, 1916 — Wet moss-G, I; leaf litter-D, J.
4. *Tectoribates latitectus* (Berlese, 1908) — Moss-F, G; leaf litter-D; lichens on red oak-C.

Family Notaspididae Oudemans, 1900

1. *Parachipteria punctata* (Nicolet, 1855) — Lichens on white oak-C; wet moss-F, G.
2. *Parachipteria willmanni* Van der Hammen, 1952 — Moss-G; lichens on white oak-C.

3. *Achipteria bella* (Sellnick, 1928) — Lichens on oaks-B, C.
4. *Achipteria nitens* (Nicolet, 1855) — Wet moss-G.
5. *Fuscozetes fuscipes* (C. L. Koch, 1844) — Very wet moss-A, E, G.
6. *Fuscozetes sellnicki* Hammer, 1952 — Very wet moss-A, G.
7. *Fuscozetes setosus* (C. L. Koch, 1840) — Moss-A, F.

Family Haplozetidae Grandjean, 1936

1. *Peloribates pilosus* Hammer, 1952 — Lichens on black oak-B; moss in rocky crevice-F.
2. *Xylobates lophotrichus* (Berlese, 1904) — Leaf litter-D; moss-F.
3. *Xylobates capucinus* (Berlese, 1908) — Moss-F.

Family Pelopidae Ewing, 1917

1. *Pelops plicatus* (C. L. Koch, 1836) — Very wet moss-A.
2. *Peloptulus americanus* (Ewing, 1907) — Moss-E.
3. *Propelops pinicus* Jacot, 1937 — Moss-F.

Family Galumnidae Grandjean, 1936

1. *Galumna virginiensis* Jacot, 1934 — Leaf litter-K; moss-I; lichens on red oaks-C.
2. *Allogalumna tenuiclavus* (Berlese, 1908) — Wet moss-G.
3. *Pergalumna nervosa* (Berlese, 1915) — Moss-F.

Cohors Ptyctima Oudemans 1906

Family Phthiracaridae Perty, 1841

Subfamily Phthiracarinae Perty, 1841

1. *Phthiracarus piger* (Scopoli, 1763) — Wet moss-G.
2. *Phthiracarus globosus* (C. L. Koch, 1841) — Wet leaf litter-D, J.
3. *Atropacarus striculus* (C. L. Koch, 1836)—Wet moss-I; leaf litter-J.

Subfamily Euphthiracarinae Jacot, 1930

1. *Oribotritia cribaria* (Berlese, 1904) — Wet leaf litter-D.
2. *Oribotritia virginiensis* Jacot, 1924 — Wet moss-A.
3. *Pseudotritia ardua* (C. L. Koch, 1841) — Wet leaf litter-D.
4. *Pseudotritia minima* (Berlese, 1904) — Moss in crevice of rock-F.

SUMMARY

From the present list which contains twenty families, fifty seven genera and ninety five species, it can be seen that the region of Mountain Lake, Virginia is particularly rich in regard to the oribatoid fauna and that this location offers abundant opportunities for further research in the taxonomy and biology of these relatively little known animals.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to the University of Virginia for providing facilities at the Mountain Lake Biological Station and to the National Science Foundation for providing the award that made possible the persuance of this research. The author also wishes to thank the American Optical Company for the use of one of their most modern microscopes during the course of this investigation.

LITERATURE CITED

BAKER, E. W., and WHARTON, G. W. 1952. An Introduction to Acarology *Macmillan and Co.*, N. Y.

SENGBUSCH, H. G. 1951. Notes on some New York oribatid mites. *Zoologica* 36 (3):155-162, 16 text-figs.

News And Notes

(*Editor's Note: News contributions should be sent to the person whose name appears at the end of the appropriate sections.*)

Mrs. Thelma C. Heatwole of Staunton, Virginia, was elected President of the Academy Conference at the annual meeting of the American Association for the Advancement of Science in New York December 26-30. The Academy Conference is the national organization of forty-one state and city Academies of Science.

Dr. John Yarborough of Meredith College, Raleigh, N. C., was named President-Elect and John G. Arnold of Loyola University, New Orleans, was elected Secretary.

—SIDNEY NEGUS, *Medical College of Virginia.*

AGRICULTURAL SCIENCE SECTION

Dr. Walter Roe has joined the staff of V.P.I. as a Veterinary Physiologist. Dr. Roe was graduated from Randolph-Macon, received his DVM from Texas with advanced work in Physiology at Minnesota. A laboratory in Veterinary Physiology is being established at V.P.I. for research and teaching. Funds for equipping this laboratory have been furnished by the Rockefeller Foundation.

Dr. George M. Boush has been appointed Associate Professor of Entomology at V.P.I. He received his MS and PhD from Ohio State. He will do research on insects affecting peanuts and other crops in the tidewater area of Virginia and will be located at the Tidewater Research Station, Holland.

Dr. Joseph L. Troutman has been appointed Assistant Plant Pathologist of the Virginia Agricultural Experiment Station and will be located at the bright tobacco research Experiment Station, Chatham, Virginia, to work on tobacco diseases. He did his undergraduate work at the University of Kentucky and received his PhD from the University of Wisconsin.

Dr. Orvin Elwood Rud has been appointed Assistant Plant Pathologist at V.P.I. to conduct research on chemical weed controls on crop plants. He will be stationed in Blacksburg. He receievd his PhD from Minnesota and his most recent position was at North Carolina State.

The Department of Dairy Science at V.P.I. is planning a Dairy Science Career Day for high school students who are planning to attend college and are interested in Dairy Science. The Virginia Dairy Products Association and the Virginia State Dairymen's Association are cooperating in the Career Day by contacting local high school students and will act as the sponsor of the students.

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Professor P. M. Reaves, of the Department of Dairy Science, V. P. I., is senior author of a new text book just off the press. The title of the book is SOUTHERN DAIRY FARMING and is published by the Interstate, Danville, Ill. The book is designed as a text for high school dairy courses.

Dr. G. C. Graf, of the Department of Dairy Science, V. P. I., appeared on the program of the annual meetings of the Virginia Dairy Products Association and the Virginia State Dairymen's Association in January. His subject dealt with the need for more college trained dairy graduates in the Dairy Industry. Dr. M. F. Ellmore was also on the program of the Virginia State Dairymen's Association and discussed the Weigh-A-Day Production Testing Program.

—CARL W. ALLEN, *Virginia Polytechnic Institute.*

BACTERIOLOGY SECTION

Dr. P. Arne Hansen has started a research project on the detection of bacteria by means of fluorescent antibodies and has been granted a contract by Fort Detrick for that purpose.

—P. ARNE HANSEN, *University of Maryland.*

SECTION OF BIOLOGY

Of particular interest to scientists is the recent announcement by Dr. Quillian that Randolph-Macon Woman's College has accepted a $350,000 gift from an anonymous donor. This money will be used to strengthen the already excellent programs in Biology and Mathematics and to stimulate an increased interest among the students for advanced work in these fields. The money from the grant will be applied partly to the General Administration, the Department of Mathematics, and to the Department of Biology of Randolph-Macon Woman's College, the bulk of the grant going to the Department of Biology. It is most gratifying to learn that a department would be so conducted as to interest a donor to grant this amount for the furtherance of science. Our congratulations to Randolph-Macon Woman's College, Department of Science.

Mr. Robert F. Smart, Professor of Biology, University of Richmond has been promoted to the Deanship at the University of Richmond to replace the late Dean Pinchbeck.

Mr. John H. Reeves formerly of the Department of Biology, Virginia Military Institute is now associated with the Department of Biology at Virginia Polytechnic Institute.

— ROBERT T. BRUMFIELD, *Longwood College.*

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ENGINEERING SECTION

An article entitled "A New Organo – Aluminum Chloride Bath for Deposition of Aluminum" by Drs. N. F. Murphy and A. C. Doumas of the Virginia Polytechnic Institute has appeared in the 43rd Annual Proceedings of the American Electroplaters Society.

The Virginia Polytechnic Institute announced that "continued study of the chemistry of aluminum compounds was confirmed by a grant of $4,600 from the National Science Foundation. This grant will support research on "Preparation and Properties of Metallic Compounds of Substituted Amines" under the direction of Professor Nelson F. Murphy and Mr. J. C. Salonish.

A paper on "Mass Transfer in Horizontal Liquid – Liquid Extraction Tube" by Professor Nelson F. Murphy, John E. Lastovica and Adam E. Skrzec has been published in the December 1956 A. I. Ch. E. Journal.

The West Virginia Pulp and Paper Company of Covington, Virginia has established a fellowship at the Virginia Polytechnic Institute for the purpose of studying the removal of color from waste, papermill streams. The studies are under the direction of Dr. N. F. Murphy and Mr. H. A. Woodle of the Chemical Engineering Department.

Dr. Frank C. Vilbrandt, Professor of Chemical Engineering, Virginia Polytechnic Institute, attended the meeting of the American Institute of Chemical Engineers at the Greenbrier Hotel, White Sulphur Springs, West Virginia, March 3 and 4, 1957.

Dr. Robert W. Truitt, head of the Department of Aeronautical Engineering, at the Virginia Polytechnic Institute will present a paper on "Flow in the Forward Stagnation Region of Blunt Bodies" at the Midwestion Conference on Fluid Mechanics to be held at the University of Michigan April 1 and 2. On April 5, Dr. Truitt will speak at the A S E E meeting at the University of Louisville on "How Do We Secure Research Facilities."

Mr. T. E. Shelburne, Director of the Virginia Council of Highway Investigation and Research, attended meetings of the Highway Research Board and the National Advisory Committee for the ASHO Road Test in January. On February 18 to 22 he attended the national meeting of the American Society of Civil Engineers in Jackson, Mississippi.

Dean Lawrence R. Quarles of the University of Virginia School of Engineering attended a meeting of the Deans and Presidents Conference on Nuclear Energy Education of the Atomic Energy Commission at the Argonne National Laboratory in Ferbuary. Dean Quarles also attended the National Convention of the Institute of Radio Engineers, which was held in New York, March 18 to 21.

R. M. HUBBARD, *University of Virginia.*

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STATISTICS SECTION

Dr. Boyd Harshbarger was elected President of the Biometric Society, Eastern North American Region, for the year 1957.

The following members of the Department of Statistics of the Virginia Polytechnic Institute attended and took part in the Joint Meeting of the Biometric Society, ENAR, and the Institute of Mathematical Statistics at the Catholic University in Washington, D. C. March 7-8: Dr. Boyd Harshbarger, Dr. R. A. Bradley, Dr. C. Y. Kramer, Dr. J. E. Freund, Dr. R. J. Freund, Mr. C. W. Clunies-Ross, Dr. R. L. Wine, and Mr. W. O. Ash.

Dr. Boyd Harshbarger presented a paper at the Ninth Research Conference which was sponsored by the American Meat Institute in Chicago, Illinois, March 21 and 22, 1957.

Recent publications of the Department of Statistics of the Virginia Polytechnic Institute include: "Some Methods of Estimating the Parameters of Discrete Heterogeneous Populations" by John E. Freund, *Journal of the Royal Statistical Society;* "Simplified Computations for Multiple Regression" by C. Y. Kramer, *Industrial Quality Control;* "On the Enumeration of Decision Patterns Involving Means" by B. L.

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Wine and J. E. Freund, *Annals of Mathematical Statistics;* "Extension of Multiple Range Tests to Group Correlated Adjusted Means" by C. Y. Kramer, *Biometrics.*

The Southern Regional Graduate Summer Session in Statistics will be held at the Virginia Polytechnic Institute during the summer of 1957. Guest lecturers will be Dr. D. B. DeLury of the Ontario Research Foundation and Dr. E. J. Williams of South Melbourne, Australia. Seminars to be given during this session include: "Multiple Decision Procedures for Ranking Means" by Robert E. Bechhofer, Cornell University; "Study of the Validity of Sampling and Testing of Materials Using the Probability Integral of the Range" by Charles A. Bicking, The Carborundum Company; "Accelerated Life Testing for Insulation Systems" by W. H. Horton, Westinghouse Electric Corporation; "Response Surface Fitting with Applications to Industry" by J. S. Hunter, Princeton University; "Statistical Estimation Problems in the Steel Industry" by Irwin Miller, U. S. Steel Corporation; "Subject to be Announced" by Robert J. Monroe, North Carolina State College; "Some Remarks on Non-Randomness of Data" by Ellis R. Ott, Rutgers University; "A Statistical Analysis of Some Deer Population Data" by Vincent Schultz, University of Maryland; "Statistics for the Control of Laboratory Tests" by Hale C. Sweeny, Atlantic Refining Company; "Subject to be Announced" by H. R. Van Der Vaart, Leiden University, Netherlands.

Norbert Llyod Enrick, head of Statistics, Institute of Textile Technology, Charlottesville, Virginia attended the recent annual Convention of the American Society for Quality Controls Textile Division, at Georgia Institute of Technology in Atlanta. He presented two papers at the meeting; "Process-to-Process Variations Analysis" and "Results of Variance Analysis of Drawing Sliver from Cooperative Tests." He also conducted training courses in industrial applications of statstical quality control for textile mill laboratory and supervisory personnel. These were held in Virginia, North and South Carolina, Georgia, and Tennessee. His series of articles on "Quality Control through Statistical Methods," which originally appeared in "Modern Textiles" Magazine is now appearing in German under the title "Qualitatetsueberwachung durch Statistische Methoden" in Reyon-Zellwolle und Andere Chemiefasern' Journal.

Virginia Academy of Science

Program

OF THE

Thirty-Fifth Annual Meeting

AT HOTEL CHAMBERLIN

OLD POINT COMFORT, VIRGINIA

May 8, 9, 10, 11, 1957

HOSTS TO MEETING

THE COLLEGE OF WILLIAM AND MARY IN VIRGINIA

AND

THE COLLEGE OF WILLIAM AND MARY, NORFOLK DIVISION

Virginia Academy of Science

OFFICERS

EDWARD S. HARLOW, *President*
WILLIAM G. GUY, *President-Elect*
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WILLIAM B. WARTMAN, JR., *Assistant Secretary*

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SIDNEY S. NEGUS (1957)
BYRON N. COOPER (1958)
WILLIAM HINTON (1959)
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LYNN D. ABBOTT, JR.
JOHN C. FORBES, JR.
ROBERT T. BRUMFIELD
CHARLES F. LANE

Ex-Officio Members

ALLAN T. GWATHMEY (1957)
IRVING G. FOSTER (1958)
WALTER S. FLORY, JR. (1959)

Local Committee on Arrangements

STANLEY B. WILLIAMS; *General Chairman.*

C. S. SHERWOOD, *III; Housing.*

MRS. MARGARET C. PHILLIPS; *Registration.*

MELVIN A. PITTMAN, MITCHELL A. BYRD, RICHARD G. CANHAM, JOHN H. LONG, HANSEL L. HUGHES, JOSEPH R. LEE; *Meeting Rooms and Equipment.*

WILLIAM G. GUY, ROGER DUDLEY; *Public Information.*

MISS JEAN PUGH; *Junior Academy Exhibits*

ALFRED R. ARMSTRONG; *Commercial Exhibits.*

J. T. BALDWIN, JR., JOHN L. MCHUGH, KENNETH A. WAGNER; *Field Trips.*

HOSTS TO MEETING

THE COLLEGE OF WILLIAM AND MARY IN VIRGINIA
THE COLLEGE OF WILLIAM AND MARY, NORFOLK DIVISION

General Program Of The 35th Annual Meeting

All meetings will be held at the Hotel Chamberlin, Old Point Comfort, Virginia

WEDNESDAY, MAY 8

5:00 P.M. to 10:00 P.M.—Registration for Junior Academy Members and Participants in the Science Talent Search. Lobby.

5:00 P.M. to 10:00 P.M.—Arrangement of Exhibits. Sun Porch.

THURSDAY, MAY 9

8:00 A.M. to 10:00 P.M.—Registration. Lobby.
(*Junior Academy members register and sign up for Jamestown tour before* 10:00 *A.M.*)

9:00 A.M. to 9:30 A.M.—Meeting of Science Exhibit Judges. John Smith Room.
Meeting of Science Talent Search Judges. Chesapeake Room.

9:30 A.M. to 10:00 A.M.—Meeting of Chairmen, Exhibitors, and Science Talent Search Participants. Virginia Room.

10:00 A.M. to 12:00 P.M.; and 1:00 P.M. to 3:00 P.M.—Finalists of Talent Search meet with Chairmen and Interviewers. Parlors A, B, C, D, E, F.

10:00 A.M. to 12:00 P.M.; and 1:00 P.M. to 3:00 P.M.—Judging of Science Exhibit Contest. Sun Porch.

2:00 P.M.—Meeting of the Council of the Academy. Chesapeake Room.

3:00 P.M. to 10:00 P.M.—Junior Academy tour to Jamestown.

4:00 P.M.—Meeting of Section Officers. John Smith Room.

4:30 P.M.—Meeting of Section Editors. Chesapeake Room.

8:00 P.M.—Academy Conference. Virginia Room.

FRIDAY, MAY 10

8:30 A.M. to 10:00 P.M.—Registration. Lobby.

9:00 A.M.—Section Meetings. See the detailed section programs for time schedule of papers.

Agricultural Sciences—Coffee Shop
Astronomy, Mathematics and Physics—Virginia Room
Bacteriology—Chamberlin Club TV Room
Biology—Roof Garden
Chemistry—John Smith Room and Chesapeake Room
Education—Parlor A
Engineering—Parlor B
Geology—Parlor C
Medical Sciences—Chamberlin Club
Psychology—Parlor D and Parlor E
Science Teachers—Parlor F
Statistics—Parlor G

12:00 Noon to 2:00 P.M.—Virginia Junior Academy of Science Assembly. Virginia Room. (See Program of Junior Academy.)

2:00 P.M. to 5:00 P.M.—Section Meetings.

3:00 P.M. to 4:30 P.M.—Tea and reception for visiting ladies given by the College Woman's Club of the College of William and Mary. Barrett Hall, East Living Room, Williamsburg campus.

8:00 P.M.—Virginia Academy of Science Assembly. Roof Garden.
Business Meeting: Election of Officers.
Presentation of the J. Shelton Horsley Research Award.
Guest Speaker: Willard F. Libby, U. S. Atomic Energy Commission, Washington, D. C.
Subject: "Atomic Energy Commission Policy and Methods"
The general public is invited to attend.

SATURDAY, MAY 11

The Section of Geology will hold a field trip to the Jamestown Island on Saturday, May 11. Leaders will be Mr. John L. Cotter, *Archeologist of the Colonial National Historical Park*, and *Dr. John T. Hack of the U. S. G. S.*

The program will include an archeological and geological tour of the island, a tour of the museum, and an illustrated lecture on the archeological excavations of the Island.

9:00 A.M.—Section Meetings.

10:00 A.M.—Meeting of the Council of the Academy.
Chesapeake Room or Parlor A (to be announced at the Thursday meeting of the Council).

Program Of The Virginia Junior Academy Of Science

All meetings will be held at the Hotel Chamberlin, Old Point Comfort, Virginia.

WEDNESDAY, MAY 8

5:00 P.M. to 10:00 P.M.—Registration for Junior Academy Members and Participants in the Science Talent Search. Lobby.

5:00 P.M. to 10:00 P.M.—Arrangement of Exhibits, Junior Academy of Science. Sun Porch.

THURSDAY, MAY 9

8:00 A.M. to 10:00 A.M.—Registration for Junior Academy Members. Lobby. Junior Members wishing to go on the tour to Jamestown must sign up before 10:00 A.M.

9:00 A.M. to 9:30 A.M.—Meeting of Science Exhibit Judges. John Smith Room. Meeting of Science Talent Search Judges. Chesapeake Room.

9:30 A.M. to 10:00 A.M.—Meeting of Chairmen, Exhibitors, and Science Talent Search Participants. Virginia Room.

10:00 A.M. to 12:00 P.M. and 1:00 P. M. to 3:00 P.M.—Finalists of Talent Search meet with Chairmen and Interviewers. Parlors A, B, C, D, E, F.

10:00 A.M. to 12:00 P.M. and 1:00 P. M. to 3:00 P.M.—Judging of Science Exhibit Contest. Sun Porch. (Encouragement of Juniors at their exhibits).

3:00 P.M. to 10:00 P.M.—Tour to Jamestown for Junior Academy Members who sign up before 10:00 A.M. at Registration Desk in Lobby. Buses for about 150 members will leave Hotel Chamberlin at 3:00 P.M. and proceed to Jamestown. The trip will include a 3-hour guided tour of the Jamestown Festival area and dinner at the College of William and Mary in Williamsburg. Buses will return to the hotel by about 10:00 P.M.

10:00 P.M.—Meeting of the Junior Academy of Science Committee. Chesapeake Room.

FRIDAY, MAY 10

9:00 A.M. to 12:00 P.M.—Participation in Senior Academy Section Meetings.

12:00 P.M. to 2:00 P.M.—Virginia Junior Academy of Science Assembly. Virginia Room. Business Meeting: Election of Officers.
Guest Speaker: Allan T. Gwathmey; *Founder of the Virginia Institute of Scientific Research and Professor of Chemistry, University of Virginia.*
Subject: "The World of Crystals"
Presentation of Awards.

Section Of Agricultural Science

PAUL M. REAVES, *Chairman*

JAMES W. MIDYETTE, JR., *Vice-Chairman*

ALLAN H. ALLISON, *Secretary*

C. W. ALLEN, *Section Editor* (1956)

FRIDAY, MAY 10—8:30 A. M.—COFFEE SHOP

8:30 Announcements and Committee Appointments

1. 8:35 Utilization of Pasture Resources by Virginia Livestock.
   Shirley H. Carter; *Virginia Polytechnic Institute.*

2. 8:50 Progress Report On The Lime Requirements of Virginia Soils.
   W. W. Moschler; *Virginia Agricultural Experiment Station.*

3. 9:05 The Determination of Available Phosphorus in Several Virginia Soils by Flouride Extraction Methods.
   Clarence C. Gray, III; *Virginia State College.*

4. 9:20 The Use Of Seed Characteristics to Check Variety Claims.
   J. W. Midyette, Jr. H. L. Smith, and Graham Copeland; *Virginia Department of Agriculture.*

5. 9:35 Effectiveness of Superphosphate and Certain Liming Materials. Topdressed on Established Pastures in Southeastern Virginia.
   Daniel L. Hallock; *Tidewater Research Station.*

6. 9:45 Evaluating Irrigation in Flue-cured Tobacco Production.
   Floyd W. Williams; *Virginia Polytechnic Institute.*

10:00 Recess

7. 10:10 Water—The Hidden Menace To Homes.
   R. C. Bricker; *Virginia Department of Agriculture.*

8. 10:35 Studies on Flavor During Storage of Dried Milk and Frozen Cream.
   W. K. Stone, Mary Kimzey and G. C. Graf; *Virginia Agricultural Experiment Station.*

9. 10:50 Some Costs Associated with Broiler Production in Virginia.
   James H. Simpson, Jr.; *Agricultural Extension Service.*

10. 11:05 The Effect of Protein Level Upon the Molybdenum—Sulphate Response in the Rat.
    N. O. Price; *Virginia Agricultural Experiment Station.*

11. 11:20 Guest Speaker:
The Plant Food Industry for 350 Years.
E. Y. Floyd; *Director, Plant Food Institute*
11:50 Adjourn for Lunch

12. 1:25 Virginia 312, A New Dark-Fire Cured Variety of Tobacco Resistant to Mosaic and Root Rot.
R. G. Henderson, R. D. Sears and Luben Spasoff; *Virginia Agricultural Experiment Station*

13. 1:40 Guest Speaker:
Virginia Field Crops for 350 Years.
M. S. Kipps; *Virginia Polytechnic Institute*
2:10 Recess

14. 2:20 Regulation of Pesticides in Virginia.
Paul E. Irwin; *Virginia Department of Agriculture*

15. 2:35 A Greenhouse Comparison of the Relative Phytotoxicity and Nematocidal Efficacy of Certain Chemical Soil Treatments.
W. Wyatt Osborne; *Virginia Polytechnic Institute*

16. 3:05 Relation of Diseases and Disease Control Practices to Quality of Raw Products for Specfiic Uses.
K. H. Garren; *U. S. Department of Agriculture.*

17. 3:20 Some Costs and Benefits in Converting Dairy Barn Operations.
Carl W. Allen; *Virginia Agricultural Experiment Station*

18. 3:35 Effects of High Oxygen Tensions on Ascorbic Acid and Vitamin A in the Rat.
Jean Swartz and C. J. Ackerman; *Virginia Polytechnic Institute*
3:50 Business Session

Section Of Astronomy, Mathematics and Physics

MELVIN A. PITTMAN, *Chairman*
EDWARD R. DYER, JR., *Secretary*
IRVING G. FOSTER, *Section Editor* (1961)

FRIDAY, MAY 10, 1957 – 10:00 A.M. – VIRGINIA ROOM

1. 10:00 A Study of Inelastic Scattering of Positive Pions.
Paul McCorkle; *College of William and Mary.*

2. 10:10 Measurement of Neutron Slowing-Down with a Liquid Scintillator.
George S. Ofelt; College of William and Mary.

3. 10:20 Scattering of Polarized 3.1-Mev. Neutrons from Be^9.
Clarence D. Bond; *University of Virginia.*

4. 10:30 Scattering of Partially Polarized Neutrons from Various Nuclei.
Billy M. McCormac; *University of Virginia.*

5. 10:40 A Versatile Heterogeneous Sub-Critical Assembly.
T. M. Schuler, Jr., A. Robeson, and T. M. Hahn, Jr.; *Virginia Polytechnic Institute.*

6. 10:50 Radio Star Scintillation Studies at the University of Virginia during the International Geophysical Year.
E. C. Stevenson and Jack T. Smith; *University of Virginia.*

7. 11:00 Population Groups among Red Dwarf Stars.
A. N. Vyssotsky; *University of Virginia.*

8. 11:10 An Unusual Variable Star.
C. R. Cowley and G. S. Mumford, III; *University of Virginia.*

9. 11:20 The Sale Planetarium of the Virginia Military Institute.
A. Roland Jones; *Virginia Military Institute.*

10. 11:30 A Recording Accelerometer.
I. G. Foster; *Virginia Military Institute.*

11. 11:40 Design and Construction of an Isotope Separation Column for a College Laboratory.
Wm. Thomas Eley; *College of William and Mary.*

11:50 Business Meeting.

12:00 Noon - 2:00 P.M. — Virginia Junior Academy of Science Assembly — Virginia Room.

FRIDAY, MAY 10, 1957 — 2:00 P.M.

12. 2:00 Experiments with Stringed Instruments.
Robert E. Smith; *College of William and Mary.*

13. 2:10 The Faraday Effect in Combined Magnetic and Radio Frequency Fields.
Frederic R. Crownfield, Jr.; *College of William and Mary.*

14. 2:20 Heat Transter between Particles and Gas in a Rocket Nozzle.
Lloyd E. Line, Jr. and Peter L. P. Dillon; *Experiment Incorporated.*

15. 2:35 Conductivity of a Still Gas with Volume Ionization.
William E. Rice; *Experiment Incorporated.*

16. 2:45 Chemiionization in Flames.
Willard E. Meador; *Experiment Incorporated.*

17. 3:05 Measurement of Lifetime of Minority Carriers in Single Silicon Crystals.
Stanley R. Jones and T. E. Gilmer, Jr.; *Experiment Incorporated.*

18. 3:15 Definition of Elementary Functions.
Robert C. Yates; *College of William and Mary.*

19. 3:25 Approximation to an Algebraic Irrational Number by a Sequence of Transformations on Quadratic Forms.
Reuben R. McDaniel; *Virginia State College.*

20. 3:40 A Magnetically Driven Ultracentrifuge.
D. Rae Carpenter, Jr. and Jesse W. Beams; *Virginia Military Institute* and *University of Virginia.*

21. 3:50 Some Improvements in the Optical System of the Ultracentrifuge.
K. D. Williams, B. V. English, and J. W. Beams; *University of Virginia.*

22. 4:00 Determination of Tensile Strength and Adhesion by Centrifugal Technique.
H. N. Bundy and J. F. McArdle; *University of Virginia.*

23. 4:10 Mechanical Strength of Polycrystalline Gold and Silver Films.
A. L. Stamper, D. E. Kraft, and T. Strider; *University of Virginia.*

24. 4:20 Tensile Strength of Liquid Helium.
J. W. Beams; *University of Virginia.*

25 4:30 The Properties of Whiskers of Zinc and Cadmium.
R. V. Coleman, B. P. Price, and N. Cabrera; *University of Virginia.*

26. 4:40 On the Maxwell-Boltzmann Energy Distribution: Advantages of Including a Constant of Proportionality in the Definition of Probability.
David E. Lundquist; *Newport News High School.*
(Introduced by Miss Susie V. Floyd)

27. 4:50 Nomographic Charts for the Solution of Kepler's Equation.
A. Hughlett Mason; *Office of the Chief of Staff, U. S. Army..*

Section Of Bacteriology

WESLEY A. VOLK, *President*

BARBARA CAMINITA, *Vice-President*

MILES HENCH, *Secretary*

P. ARNE HANSON, *Section Editor* (1957)

FRIDAY, MAY 10, 1957—11:00 A.M.—CHAMBERLIN CLUB TV ROOM

11:00 A.M. Business Meeting

12:00 Noon Recess

1:50 P.M. Presentation of Scientific Papers.

2:00 P.M. A Study of Bactericidin Levels in Sera From Humans With Myocardial Infarction.

George Naff, Department of Microbiology; *University of Virginia, School of Medicine.*

2:20 P.M. Some Observations on pH Controlled *Endamoeba histolytica* Cultures.

E. Clifford Nelson and Muriel Jones; *Department of Microbiology, Medical College of Virginia.*

2:40 P.M. Identification of *Escherichia coli* by the Fluorescent Antibody Technique.

Walter R. Dowdle; *Department of Bacteriology, University of Maryland;* Margaret Green and Mildred Engelbrecht; *Department of Bacteriology, University of Alabama.*

3:00 P.M. Growth of HeLa Cells in the Presence of Anti-HeLa Cell Rabbit Serum.

Gerald Goldstein; *Department of Microbiology, University of Virginia, School of Medicine.*

3:20 P.M. Comparison of Isolation Techniques and Methods for the Diagnosis of Onychomycosis.

Muriel M. Jones, J. Douglas Reid, and Albert Pincuf; *Department of Microbiology, Medical College of Virginia.*

3:40 P.M. Observations on Human Mucosa in Tissue Culture.
Catherine M. Russell; *Department of Microbiology, University of Virginia, School of Medicine.*

4:00 P.M. Adjourn.

Section of Biology

JACK D. BURKE, *Chairman*

HARRY L. HOLLOWAY, *Secretary*

ROBERT T. BRUMFIELD, *Section Editor* (1957)

FRIDAY, MAY 10, 1957 — 9:00 A. M. — ROOF GARDEN

1. 9:00 Preliminary Survey of Aquatic Hyphomycetes on Angiosperm Debris.
Clyde J. Umphlett; *Virginia Polytechnic Institute.*

2. 9:15 Hybridization in *Ipomoea* and Its Relatives.
Robert J. Knight; *The Blandy Experimental Farm.*

3. 9:30 A Biosystematic Study of *Rosa acicularis.*
Walter H. Lewis; *The Blandy Experimental Farm.*

4. 9:45 The Effect of Indoleacetic Acid on Certain Growth Phases of Mosses.
Paul M. Patterson; *Hollins College.*

5. 10:00 Weekly Fluctuation of an Unstable Beach.
K. A. Wagner; *College of William and Mary in Norfolk* and W. W. McNeil; *Seashore State Park.*

6. 10:15 *Chlorella* and The Nitrogen Cycle.
Kathryn P. Smith; *Newport News High School.* Honorable Mention, National Science Talent Search.

7. 10:30 Preservation of Plant Materials for Collections.
Mary V. Charlton; *Buckingham High School.* Honorable Mention, National Science Talent Search.

8. 10:45 Unit and Polygenic Traits as Indicators of Population Relationship.
B. L. Hanna and Mary Ellen Dechert; *Medical College of Virginia.*

9. 11:00 The Sex Bivalent of the Chinese Hamster, *Crisetulus griseus.*
L. Husted, E. G. Pollock, and G. C. Smart, Jr.; *University of Virginia.*

10. 11:15 Silver Impregnation of a Rockpool Hypotrichous Ciliate from Mountain Lake.
Jesse C. Thompson; *Hollins College.*

11. 11:30 Observations on the Fresh-water Medusa, *Craspedacusta sowerbii,* Occurring in a Pond in Southampton Quarry.
Nolan E. Rice; *University of Richmond.*

12. 11:45 The Host Specificity of Monogenetic Trematodes.
William J. Hargis; *Virginia Fisheries Laboratory.*

13. 12:00 The Distribution of *Neoechinorhynchus cylindratus* in North America.
Harry L. Holloway; *Roanoke College.*

14. 12:15 Chaetonotid Gastrotrichia in Ashland, Virginia.
C. E. Packard; *Randolph-Macon College.*

12:30 BUSINESS MEETING

FRIDAY, MAY 10 — 2:00 P.M.

15. 2:00 Alkaline Phosphatase in Turbellaria.
Paul J. Osborne; *Lynchburg College.*

16. 2:15 The Life History of the Lesser Peach Tree Borer in Virginia.
Marvin L. Bobb; *Virginia Agricultural Experiment Station.*

17. 2:30 Invitational Paper. The Chemical Senses of Arthropods.
E. S. Hodgson; *Columbia University* and *Mountain Lake Biological Station.*

18. 3:00 Comparative Osteology of Serranid Fishes of the Genus *Roccus* (Mitchell).
William S. Woolcott, Jr.; *University of Richmond.*

19. 3:15 The Effects of Population on Virginia's Marine Fisheries.
J. L. McHugh; *Vrginia Fisheries Laboratory.*

20. 3:30 Blood Oxygen Capacity in Albino Rats.
Jack D. Burke; *University of Richmond.*

21. 3:45 Milieu and the Manner of Melanocytes.
Willie M. Reams, Jr.; *Medical College of Virginia.*

22. 4:00 Blood Oxygen Capacity in Turtles.
Harold J. Payne; *University of Richmond.*

23. 4:15 Blood Oxygen Capacity in the Black Crappie (*Pomoxis nigromaculatus*) and the Bluegill (*Lepomis macrochirus*).
William S. Woolcott, Jr.; *University of Richmond.*

SATURDAY, MAY 11 – 9:00 A. M.

9:00 Field trip to Seashore State Park, Princess Anne County; under the direction of Kenneth A. Wagner.

Section Of Chemistry

MARY E. KAPP, *Chairman*

JOSEPH C. HOLMES, *Secretary*

CARL J. LIKES, *Section Editor* (1957)

FRIDAY, MAY 10, 1957 – 9:00 A.M. – JOHN SMITH ROOM

Concurrent Session In Chesapeake Room

9:00 Announcements; Introductory Remarks.

(1) 9:15 Some Experiments Using Phenyl Acid Phosphate as a Cyclizing Agent.
F. A. Vingiello, M. Spangler, W. Zajac, R. Thornton, R. Stevens, M. Schlechter, and R. Light; *Virginia Polytechnic Institute.*

(2) 9:30 An Unequivocal Synthesis of 3-Chloro-9-Anthrone.
F. A. Vingiello, P. Newallis, and M. Schlechter; *Virginia Polytechnic Institute.*

(3) 9:45 Some Ionic Addition Reactions of Two Isomeric 3-methyldihydrothiophene 1,1-Dioxides.
Robert C. Krug and Francois E. Didot; *Virginia Polytechnic Institute.*

(4) 10:00 Molecular Weight Determination by Effusion Constants.
Charles J. Varsel, John P. Bell, Joseph C. Holmes, and Frank E. Resnik; *Philip Morris Incorporated.*

(5) 10:15 The Clarification of Aqueous Tobacco Extracts Prior to Determining Reducing Sugars. A Preliminary Report.
F. L. Greene and Robert B. Seligman; *Philip Morris Incorporated.*

10:30 Recess

(6) 10:45 Micro Infra-red Techniques for the Identification of Carbohydrates.
F. E. Resnik, L. S. Harrow, J. C. Holmes, M. E. Bill, and F. L. Greene; *Philip Morris Incorporated.*

(7) 11:00 Studies of Tobacco Leaf Proteins. Donald F. Koenig, James K. Palmer, and Carl J. Likes; *Johns Hopkins Hospital* and *Virginia Institute for Scientific Research.*

(8) 11:15 Distribution of Radioactivity in Main and Side Stream Cigarette Smoke Using Carbon-14 Labeled Materials.
P. M. Pedersen and E. S. Harlow; *The American Tobacco Company.*

(9) 11:30 The Respiration of the Tobacco Plant. I. Oxidation of Hexose Phosphate and Pentose Phosphate by Cell-free Extracts of Tobacco Leaves.
R. A. Clayton; *The American Tobacco Company.*

(10) 11:45 The Spectrophotometric Determination of Total Carbonyl Content Utilizing Integrated Absorbence Measurements.
L. S. Harrow, J. T. Butler, F. E. Resnik, A. C. Estes, M. E. Bill and R. B. Seligman; *Philip Morris Incorporated.*

12:00 Business Meeting.

FRIDAY, MAY 10, 1957 – 9:00 A. M. – CHESAPEAKE ROOM

(11) 9:15 Spectrochemical Determination of Certain Trace Metals in Human Blood.
Leonel M. Paixao; *Pratt Trace Analysis Laboratory, University of Virginia.*

(12) 9:30 A Spectrophotometric Method for the Determination of Chromium in Human Blood.
Dwight O. Miller; *Pratt Trace Analysis Laboratory, University of Virginia.*

(13) 9:45 Simultaneous Spectrophotometric Determination of Traces of Copper, Cobalt and Nickel with Dithiooxamide.
William D. Jacobs; *Pratt Trace Analysis Laboratory, University of Virginia.*

(14) 10:00 A New Colorimetric Reagent for Uranium.
H. Perry Holcomb; *Pratt Trace Analysis Laboratory, University of Virginia.*

(15) 10:15 Structural Analysis of the Napthylamine Sulfonic Acid-Osmate Complexes with Application to the Determination of Trace Amounts of Osmium.
Edgar L. Steele and John H. Yoe; *Pratt Trace Analysis Laboratory, University of Virginia.*

10:30 Recess

(16) 10:45 The Dissociation Pressures of the Tantalum Silicides.
Clifford E. Meyers and Alan W. Searcy; *Lynchburg College* and *University of California.*

(17) 11:00 A Modification of the Turmeric Paper Test for Boron.
W. Allan Powell, Emmet H. Poindexter and James Hardcastle; *University of Richmond.*

(18) 11:15 Combustion of Carbon Disulfide - Air Mixtures.
George J. Gibbs, Irving R. King and Hartwell F. Calcote; *Experiment Incorporated.*

(19) 11:30 Microscopic Examination of Incandescent Surfaces.
Claud P. Talley and Everett J. Nieuwenhuis; *Experiment Incorporated.*

(20) 11:45 Whisker Growth of Silver Metal. Mechanism and Kinetics.
Welby G. Courtney; *Chemical Construction Corporation.*

12:00 Business Meeting — John Smith Room.

FRIDAY, MAY 10 — 2:00 P.M.

(21) 2:00 Copolymerization of vinyl chloride and styrene.
Joseph Clema; *National Science Talent Search.*

(22) 2:15 Preparation of Dipyrrylmethylpyrocolls. Catalytic Reduction of 3,5,4' - Tricarbethoxy - 4,3', 5' - trimethylpyrromethene.
Bryant Harrell and Alsop H. Corwin; *The College of William and Mary* and *Johns Hopkins University.*

(23) 2:30 Ultracentrifugal Studies of Aggregation Occurring in Alkaline Zein Solutions.
Carl J. Likes and Donald F. Koenig; *Virginia Institute for Scientific Research* and *Johns Hopkins Hospital.*

(24) 2:45 Synthesis and Properties of Pyridylalanines.
Herbert McKennis, Jr., and Edward R. Bowman; *Medical College of Virginia.*

(25) 3:00 The Determination of Residues of *0*-2,4-Dichlorophenyl *0*-O-diethyl Phosphorothioate (V-C 13 Nemacide) by Cholinesterase Inhibition.
George R. Boyd; *Virginia-Carolina Chemical Corporation.*

(26) 3:15 Chemical Library Resources In Virginia.
Miss M. Hathaway Pollard; *Virginia-Carolina Chemical Corporation.*

(27) 3:30 Nuclear Reactors for Research.
W. E. Chamberlain; *AMF Atomics, Incorporated.*

Section Of Education

W. DONALD CLAGUE, *Chairman*

EVAN G. PATTISHALL, *Secretary*

JAMES B. PATTON, JR., *Section Editor* (1960)

FRIDAY, MAY 10, 1957 — 9:00 A.M. — PARLOR A

1. 8:30 Registration.
2. 9:00 The quality of Written Expression of Virginia's High School Seniors.
   Alfred L. Wingo; *State Department of Instruction.*
3. 9:20 Changes in Attitudes Resulting from Training in Educational Psychology.
   Charles Martindale and George Kent; *Bridgewater College.*
4. 9:40 Some Effects of College Mental Hygiene Courses in Personal Development.
   George Kent; *Bridgewater College.*
5. 10:00 Recess
6. 10:20 An Experiment in Cooperative, Non-cooperative and Individual Performance.
   Frank W. Banghart; *University of Virginia.*
7. 10:40 Evaluating Behavior Traits in Elementary Science.
   Jack Boger; *Richmond Public Schools.*
8. 11:00 Mental Maturation Lag in Retarded Children.
   Thomas Lahey; *Charlottesville Public Schools.*
9. 11:20 Symposium: Needed Research on the Gifted Child.
   Mike Alford; *Norfolk Public Schools;* Virgil Ward; *University of Virginia;* Kuhn Barnett; *State Department of Instruction;* Leon Reid; *University of Virginia;* Evan Pattishall, Chairman; *University of Virginia.*
10. 12:30 Business Meeting and Election of Officers.
11. 1:00 Adjournment.

Section Of Engineering

D. M. CRIM, *Chairman*

O. L. UPDIKE, *Secretary*

R. M. HUBBARD, *Section Editor* (1958)

FRIDAY, MAY 10, 1957 – 9:00 A.M. – PARLOR B

9:00 Announcements, Committee Appointments, etc.

1. 9:10 An Investigation of Some Aspects of Transonic Wind Tunnel Design.
   Arthur C. Bruce; ***Virginia Polytechnic Institute.***

2. 9:30 Determination of the Aerodynamic Characteristics of Bodies of Revolution in an Axially Symmetric Perfect Fluid Flow by the Method of Vortex Ring Distribution.
   Charles R. Wilson and James B. Eades, Jr.; *Virginia Polytechnic Institute.*

3. 9:55 Some Consideration of the Transonic Area Rule.
   Edgar B. Pritchard and Arthur C. Bruce; *Virginia Polytechnic Institute.*

4. 10:15 Flow in the Forward Stagnation Region of Blunt Bodies.
   Robert W. Truitt; *Virginia Polytechnic Institute.*

5. 10:35 Aerodynamic Heating on Bodies of Revolution Including Slip Flow.
   Adolf K. Anderson, Jr., and Robert W. Truitt; *Virginia Polytechnic Institute.*

6. 10:55 Structural Problems Due to Aerodynamic Heating of Supersonic Airframes.
   William Zuk; *University of Virginia.*

7. 11:15 Process Design for the Production of Maleic Acid Hydrazide for Weed Control.
   E. C. Moncrief, W. H. Sawyer, and Frank C. Vilbrandt; *Virginia Polytechnic Institute.*

8. 11:30 Planning Problems in the Washington Metropolitan Area of Virginia.
   J. E. Woodward; *Virginia Military Institute.*

12:00 Recess.

9. 2:00 A Molecular Lens.
Paul R. Little, Robert L. Ramey, and Orville R. Harris; *University of Virginia.*

10. 2:30 An Investigation of the Modified Newtonian-Type Flow Over a Flat Plate.
F. Wendell Johnson and Robert W. Truitt; *Virginia Polytechnic Institute.*

11. 2:50 Determination of Pressure Drag on Bodies of Revolution in Transient Flight.
Samuel J. Harris, III, and Robert W. Truitt; *Virginia Polytechnic Institute.*

12. 3:10 An Investigation of Modified Newtonian Hypersonic Theory in the Stagnation Region of Cylindrical and Hemispherical Bodies.
Jerry C. South, Jr., and Robert W. Truitt; *Virginia Polytechnic Institute.*

13. 3:30 Experimental Compressible Pressure Distributions and Velocity Gradient on a 180° Wedge.
Paul Taynton and Arthur C. Bruce; *Virginia Polytechnic Institute.*

3:50 Engineering Exhibits — Presentation by Members of the Virginia Junior Academy of Science.
5:00 Business Meeting and Election of Officers.

Section Of Geology

TROY J. LASWELL, *Chairman*
RICHARD V. DIETRICK, *Vice-Chairman*
ROBERT S. YOUNG, *Secretary*
WALLACE D. LOWRY, *Section Editor* (1958)

FRIDAY, MAY 10, 1957 — 9:00 A.M. — PARLOR C

9:00 Announcements

1. 9:10 Magnetic Intensities of Some Rocks in the Vicinity of Lynchburg, Va.
Robert Hopkins; *Virginia Division of Geology.*

2. 9:22 Study of Heavy Minerals in Sands of South River, Rockbridge County, Virginia.
James R. Creel, James H. Davis, and Robert B. Lurate; *Washington and Lee University.*
Presented by James H. Davis.

3. 9:34 Desiderata for the "Representative Sample."
A. C. Lilly, Jr.; *Virginia Polytechnic Institute.*

4. 9:46 Structural Polytypism and the Spiral Growth of Crystals.
Richard S. Mitchell; *University of Virginia.*

5. 9:58 Weathered Stream Gravels at the Crest of the Blue Ridge.
R. V. Dietrick; *Virginia Polytechnic Institute.*

6. 10:15 Vermiculite in Virginia.
Edwin O. Gooch; *Virginia Division of Geology.*

7. 10:30 Zircon in Bentonite in the Martinsburg Shale at Fisher's Hill, Virginia.
Dorothy Carroll; *United States Geological Survey.*

8. 10:44 Heavy Mineral Studies of Sediment from Little River, Floyd County, Virginia.
Carl R. Mangold, Jr., Lee Marshall, and William K. Young; *Washington and Lee University.*
Presented by Carl R. Mangold, Jr.

9. 10:56 Description of Large Calcite Crystals from Staunton, Virginia.
William F. Giannini; *University of Virginia.*

10. 11:08 Non-tectonic Folds in the Athens Formation, near Harrisonburg, Virginia.
W. D. Lowry; *Virginia Polytechnic Institute.*

11. 11:25 Chert in the Murat-Collierstown Area, Rockbridge County, Virginia.
R. S. Edmundson; *University of Virginia.*

12. 11:37 Remarks on Spherulitic Phosphate Concretions from Big Horn Basin, Wyoming.
Richard S. Mitchell and W. Cullen Sherwood; *University of Virginia.*

13. 11:50 Origin of Ordovicean Dolomite-Bearing Carbonate Rocks in Virginia.
C. R. B. Hobbs, Jr.; *Virginia Polytechnic Institute.*

14. 12:00 Relationship of Igneous Intrusion To North Mountain Thrusting, North River Gap Area, Virginia.
Mark Fara; *Virginia Polytechnic Institute.*

12:10 Recess

AFTERNOON PROGRAM TO BE ANNOUNCED

Section Of Medical Science

L. E. EDWARDS, *Chairman*

G. M. DUNCAN, *Secretary*

W. P. ANSLOW, JR., *Section Editor* (1961)

FRIDAY, MAY 10, 1957 – 9:00 A.M. – CHAMBERLIN CLUB ROOM

9:00 Announcements.

1. 9:05 Studies on the Metabolism of Nornicotine.
H. B. Hucker and P. S. Larson; *Medical College of Virginia.*

2. 9:20 Dialysis as an Analytical Tool.
H. Hock and R. C. Williams; *Medical College of Virginia.*

3. 9:40 Effects of Oral Hypoglycemic Compounds on the Metabolism of Isolated Intact Frog Muscle.
D. R. H. Gourley; *University of Virginia.*

4. 10:00 Motion Pictures of Tissue Changes in Regenerating Zones of Irradiated Tadpoles.
C. C. Speidel; *University of Virginia.*

5. 10:20 Transport of Dye by Renal Tubular Cells. (Film)
E. L. Becker and S. Solomon; *Medical College of Virginia.*

6. 10:40 Reactions of Enzymes with Toxic Phosphorus Compounds.
L. A. Mounter; *Medical College of Virginia,* and H. C. Alexander III; *University of Virginia.*

7. 11:00 Irreversible Shock Produced by Temporary Cerebral Ischemia in Cats.
E. D. Brand; *University of Virginia.*

8. 11:20 Histochemical Studies on Trypan Blue and Related Dyes.
J. W. Kelly; *Medical College of Virginia.*

9. 11:40 Metabolic Effects of Triiodothyronine Given Orally to Rats.
C. L. Gemmill; *University of Virginia.*

11:55 Business Meeting.

10. 2:00 Some Factors Influencing Gross Composition of the Fat-Free Body.
G. C. Pitts; *University of Virginia.*

11. 2:20 The Effect of Pentobarbital on the Uptake of p32 in the

Brain, Endocrines and Other Organs in the Adult Rat.
P. Lindgjerde and O. J. Malm; *Medical College of Virginia.*

12. 2:40 Hypogammaglobulinemia in Children.
C. Hoch-Ligeti and J. P. Hobbs; *University of Virginia.*

13. 3:00 Indirect Hemagglutination Studies on Salmonellosis of Chickens.
J. M. Sieburth; *Virginia Agricultural Experiment Station.*

14. 3:20 *E. coli* as a Pathogen in Chickens and Turkeys.
W. B. Gross; *Virginia Agricultural Experiment Station.*

15. 3:40 Exchange Absorption Mechanism of Active Ion Transport.
E. G. Huf, N. Doss, and J. Wills; *Medical College of Virginia.*

16. 4:00 An Experimental Analysis of the Genetotrophic Theory of Alcoholism.
E. C. Hoff; *Medical College of Virginia.*

17. 4:20 Effect of Perthane on Spontaneous Mammary Carcinoma in the C3H Mouse.
L. A. Leone; *Medical College of Virginia.*

18. 4:40 Effects of X-Irradiation on Guinea Pig Brain, with Special Reference to the Age Factor.
R. H. Brownson and B. A. Moss; *Medical College of Virginia.*

19. 5:00 Menometric Determinations of Hydrazine and Hydrazides.
H. McKennis, Jr. and J. H. Weatherby; *Medical College of Virginia.*

Section Of Psychology

FRANK W. FINGER, *Chairman*

ROBERT J. FILER, *Secretary-Treasurer*

NOBEL MCEWEN, *Executive Committeeman*

RICHARD H. HENNEMAN, *Section Editor* (1959)

FRIDAY, MAY 10, 1957 – 1:00 P.M. – PARLOR D AND PARLOR E

1. 1:00 The influence of conditional probability, interpolated activity and stimulus similarity upon responses to sequentially presented stimuli.
John B. Feallock; *University of Virginia.*

2. 1:15 The effects on retention of two motor activities used as interpolated tasks.
   Albert M. Blecich and Nobel R. McEwen; *Randolph-Macon College.*

3. 1:30 Irrelevant stimuli and complex visual discrimination.
   Milton H. Hodge; *University of Virginia.*

4. 1:45 An olfactometer for the rat.
   Carl Pfaffmann, *Brown University;* J. K. Bare, *College of William and Mary;* William R. Goff, *University of Virginia.*

5. 2:00 Motivational support of perceptual hypotheses.
   Charles C. Keach; *Alexandria Mental Hygiene Clinic.*

6. 2:15 The changing role of the psychotherapist in the treatment of schizophrenia.
   A. W. Jeffreys, Jr.; *Western State Hospital.*

7. 2:30 Cutaneous adaptation to alternating current.
   G. R. Hawkes; *University of Virginia.*

8. 2:45 Derived dimensions of vibratory stimulation.
   William C. Howell; *University of Virginia.*

9. 3:15 Functions of psychological organizations at the state level.
   William Hinton, *Moderator; Washington and Lee University.*

10. 4:45 Business Meeting.

SATURDAY, MAY 11 — 9:15 A.M.

11. 9:15 Manifest content and interpretative meaning of verbal intelligence test responses.
    Norman Tallent; *Kecoughtan Veterans Administration Center.*

12. 9:30 Therapeutic validation of the A scale.
    Dell Lebo, *Richmond Professional Institute;* Robert A. Toal, *Medical College of Virginia;* and Harry Brick, *Virginia State Penitentiary.*

13. 9:45 Normative data for a multiple-choice TAT.
    John E. Williams; *University of Richmond.*

14. 10:00 The effect of recitation on recall.
    F. J. McGuigan, Allen D. Calvin, Martha M. Myers, and Elizabeth J. Hobbs; *Hollins College.*

15. 10:15 Flexibility in relation to problem-solving ability.
    William F. Battig; *University of Virginia.*

16. 10:30 "Quickening" techniques in improving tracking performance.
Henry P. Birmingham, *Engineering Psychology Branch, Naval Research Laboratory* and Patricia A. Rund; *University of Virginia.*

17. 10:45 An experiment with complex verbal behavior.
William E. Montague; *University of Virginia.*

18. 11:00 The self concept as a means of determining personality types in a population of delinquent boys.
Cletus A. Cole; *Arlington County Schools.*

19. 11:30 Business Meeting.

Section Of Science Teachers

SAMUELLA CRIM, *Chairman*

VERA B. REMSBERG, *Chairman-elect*

MARTHA W. DUKE, *Secretary*

CAROLINE GAMBRILL, *Section Editor* (1959)

FRIDAY, MAY 10, 1957 – PARLOR F

1. Business Meeting 9:00-9:30 A.M.

2. 9:30-9:50 Conservation of Fishery Resources.
L. A. Walford; *U. S. Fish and Wildlife Service.*

3. 9:50-10:10 Motivation of the Superior Science Student.
Miss Virginia Lewis; *Culpeper High School.*

4. 10:10-10:30 Recent Trends in the Teaching of Science.
John Mayor; *Director, Science Teachers Program, AAAS.*

5. 10:30-10:50 The Possibility of Using Marine Forms in the Science Programs of our schools.
Robert S. Bailey; *Asst. Biologist, Virginia Fisheries Laboratory.*

6. 10:50-11:10 The Respective Roles of Industry and Education in the Enrichment of Science Teaching.
Paul Caron; *General Electric Co.*

7. 11:10-11:30 Atomic Energy Development in Virginia.
W. M. Breazeale; *Babcock and Wilcox Co.*

8. 11:30 Discussion, Adjournment.

Section Of Statistics

J. E. FREUND, *Chairman*

E. L. ENRICK, *Vice-Chairman*

C. Y. KRAMER, *Secretary*

P. N. SOMERVILLE, *Section Editor* (1959)

FRIDAY, MAY 10, 1957 – 9:00 A. M. – PARLOR G

1. 9:00 Introductory Remarks by the Chairman.

2. 9:05 Some Results on Cross Spectrum Estimation.
A. E. Garratt and J. E. Freund; *Virginia Polytechnic Institute.*

3. 9:30 Simultaneous Prediction Limits.
J. J. Gart; *Virginia Polytechnic Institute.*

4. 9:55 Intra-Block Analysis for Factorials in Two-Associate Class Group Divisible Designs.
C. Y. Kramer and R. A. Bradley; *Virginia Polytechnic Institute.*

10:20 Intermission

5. 10:30 The Statistical Foundations of Climatology.
H .C. S. Thom; *U. S. Weather Bureau.*

6. 11:30 Business Meeting.

FRIDAY, MAY 10, 1957 – 2:00 P.M.

7. 2:00 A Multivariate Rank-Sum Test.
L. Lynch, and J. E. Freund; *Virginia Polytechnic Institute.*

8. 2:25 One-Way Variances in a Two-Way Classification.
T. S. Russell and R. A. Bradley; *Washington State College* and *Virginia Polytechnic Institute.*

9. 2:50 Statistical Consulting in Industry.
I. Miller; *U. S. Steel Corporation.*

10. 3:20 Linear Discriminant Analysis.
R. H. Riffenburgh and C. W. Clunies-Ross; *Virginia Polytechnic Institute.*

11. 3:45 Trends Within Blocks.
H. A. Still and R. A. Bradley; *Virginia Polytechnic Institute.*

SATURDAY, MAY 11, 1957 — 9:00 A.M.

12. 9:00 Randomized Power Spectrum Estimation.
W. O. Ash and J. E. Freund; *Virginia Polytechnic Institute.*

13. 9:25 Possibility of Monozygotic Twins in Mice.
C. W. Clunies-Ross; *Virginia Polytechnic Institute.*

14. 9:50 A Method and Its Properties for the Analysis of Ranking in Triple Comparisons.
R. N. Pendergrass and R. A. Bradley; *Radford College* and *Virginia Polytechnic Institute.*

15. 10:15 On the Analysis of Residuals from Regression.
R. J. Freund; *Virginia Polytechnic Institute.*

10:40 Intermission

16. 10:50 The Comparison of the Sensitivities of Similar Experiments.
D. E. W. Schumann and R. A. Bradley; *University of Stellenbosch, South Africa,* and *Virginia Polytechnic Institute.*

17. 11:15 Effects of Underlying Trends in Experimental Designs.
Jean Laity; *Virginia Polytechnic Institute* (By Title).

MINUTES OF THE VIRGINIA ACADEMY OF SCIENCE

COUNCIL MEETING

Charlottesville, Virginia — February 23, 1957

The Council of the Virginia Academy of Science met at the Monticello Hotel, Charlottesville, Virginia. The meeting was called to order by the President at 10:30 a.m.

Council members present were:

Edward S. Harlow	Walter S. Flory
William G. Guy	Mrs. B. G. Heatwole
Sidney S. Negus	Thomas L. Gilmer
John C. Forbes	Foley F. Smith
Robert Brumfield	William B. Wartman, Jr.

Also present was Dr. Alfred R. Armstrong, representing the Local Arrangements Committee for the 1957 meeting.

The minutes of the previous meeting were read by the Secretary-Treasurer and were approved as read.

The following items were discussed and action taken as noted.

FUNDS FOR SURVEY OF THE RESULTS OF THE VIRGINIA SCIENCE TALENT SEARCH

E. S. Harlow reported that the Academy's application to the National Science Foundation for funds to finance a survey of the results of the Virginia Science Talent Search had been rejected. Several members suggested other possible sources for these funds, and Mrs. Heatwole was requested to refer the matter to the Chairman of the Long Range Planning Committee. This committee is requested to investigate other possible sources of funds to finance this project.

REPORT OF THE FINANCE COMMITTEE

The Secretary-Treasurer read the report of the Finance Committee. Recommendations of this committee were taken up in the following order:

Audit of the Treasurer's Records — The Finance Committee recommended that the Treasurer's records be audited by an accountant every two or three years, with an examination of the records during the intervening years by a committee of Academy members appointed by the President. Since an audit now costs $225.00, this would result in a considerable saving to the Academy. The Finance Committee recommendation also provided for the raising of the Treasurer's bond from $5,000.00 to $10,000.00.

A motion was made and passed that the Treasurer's records be audited by an accountant bi-annually or at such other times as requested by the officers of the Academy, with an examination during the intervening years to be made by a committee appointed by the President; also, that the Treasurer's bond be raised from $5,000.00 to $10,000.00.

Additional Revenue for the Academy – It was reported by Dr. Negus that the Membership Committee is attempting to obtain new members at various facilities throughout the State and, through correspondence, is making a concerted effort to secure new members among the science teachers in the State.

As recommended by the Finance Committee, a motion was made and passed that the President appoint a committee to solicit additional business members and that a stamp, with its context urging all regular members to become contributing or sustaining members, be used on all future billings to regular members.

Additional Funds for Research Grants-in-Aid – Dr. Forbes pointed out that an $1,800.00 surplus from the Research Fund had been transferred to the Research Endowment Fund in 1955. He further reported that he had already received this year applications for grants-in-aid totaling $600.00 in excess of funds available. As a consequence, it was moved and passed that the President and Secretary arrange for the transfer of $800.00 from the Research Endowment Fund to the Research Committee for research grants-in-aid.

Dr. Forbes expressed the feeling that there were many teachers, particularly in the smaller colleges of the State, who pursued research projects during the summer and their efforts would be intensified if they could get financial assistance in the amount of $100.00 to $200.00. He proposed that the Research Fund for grants-in-aid be increased an additional $500.00 so that such assistance might be made available to a few applicants each year. Recognizing the fact that support of research in the State is one of the prime functions of the Academy, it was moved and passed that the sum of $500.00 be included in the annual budget of the Academy, beginning with the current calendar year; this sum to be made available, if needed, to the Research Committee for such research grants-in-aid, and to be in addition to funds already available to the Research Committee.

Dr. Forbes requested the opinion of Council on the idea that recipients of grants-in-aid provide the Research Committee with an abstract of their progress on their research projects and publication of these abstracts in the Proceedings of the Academy. Council was in sympathy with the idea and requested Dr. Forbes to work out the mechanics of publication with the Editor of the Journal.

The 1957 Budget – The 1957 budget, as submitted by the Finance Committee, was approved after making the following changes:

(1) Deleting the item "Audit – Tax Service – $225.00"
(2) Adding "Research Fund for Grants-in-Aid – $500.00"

REPORT OF THE JUNIOR ACADEMY OF SCIENCE COMMITTEE

Mrs. Heatwole reported that she had just recently attended a Junior Academy Conference arranged by The Academy Conference of the American Association for the Advancement of Science and the Museum Division of the Oak Ridge Institute of Nuclear Studies. At this conference several proposals were made, some of which would require action by the Academy Conference. One of these proposals concerned the establishment of regional workshops for secondary school science students. She reported that she was drafting a list of these proposals which would be disseminated to Council members.

THE J. SHELTON HORSLEY AWARD

Dr. Forbes requested the feeling of Council on a proposal that he ask the various chairmen of sections, in which papers were submitted for the Horsley Award, to designate a representative of the section to aid the Research Committee in evaluating the papers submitted by members of their respective sections. It was the feeling of Council that the mechanics of operation in selecting the winning papers was entirely a Research Committee function and Council had no objection to the *modus operandi* proposed by Dr. Forbes.

PRESENT STATUS OF THE SEASHORE STATE PARK SCIENCE CENTER PROPOSAL

The President reviewed the present status of this proposal as contained in a memo to Council members dated January 14, 1957. The proposal is still under consideration by the Board of Conservation and Development, and subsequent developments will be promulgated to Council members.

PROPOSED CHANGES IN THE CONSTITUTION AND BYLAWS OF THE VIRGINIA ACADEMY OF SCIENCE

A proposal for changes in the Constitution and Bylaws of the Virginia Academy of Science to increase the number of officers to five – such officers to be the President, President-Elect, Secretary, Treasurer and Assistant Secretary-Treasurer – was introduced by the President. Revisions in the Constitution and Bylaws can be initiated only by notifying Council members of such proposed changes at least thirty days prior to the call for a formal vote. For final approval, revisions approved by

the Council are presented to the membership prior to the annual meeting. Council was in complete accord with the proposal and it is expected that a resolution to revise the Constitution and Bylaws will be formally approved by them at their scheduled meeting, Thursday, May 9, 1957.

The burden of correspondence to both the Office of Secretary-Treasurer and of President has increased exceedingly in the past few years. Hence, it was felt that the separation of the Office of Secretary-Treasurer into two offices — Secretary and Treasurer — would tend to alleviate this situation. In addition, the Secretary would (without the financial responsibilities) be in a better position to perform the administrative duties of his office and relieve the President of considerable responsibility along this line. The Office of the Assistant Secretary-Treasurer will provide one individual to assist both the Secretary and the Treasurer in the performance of their duties and will allow for at least two individuals to be thoroughly informed of all business operations of the Academy.

REPORT OF THE LOCAL ARRANGEMENTS COMMITTEE FOR THE 1957 MAY MEETING

Dr. Stanley Williams, Chairman of this committee, was unable to attend and Dr. Alfred Armstrong of the College of William and Mary reported for the Committee. Dr. Armstrong reported that plans for the 1957 meeting are well under way and stressed the importance of members, who plan to attend the meeting, making housing reservations immediately. He proposed that a notice of the urgency in making housing reservations be mailed to each member. The Secretary-Treasurer was requested by Council to mail such a notice to the members and to include a notice of the proposed changes in the Constitution and Bylaws.

REPORT OF THE EDITOR OF THE JOURNAL

Dr. Brumfield reported that the January issue of the Journal would be mailed to members of the Academy in the next few days.

There being no further business, the meeting was adjourned at 12:45 p.m.

William B. Wartman, Jr.
Asst. Secretary